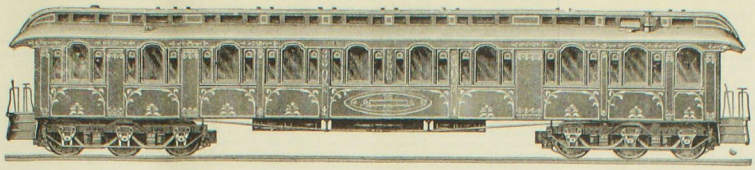
NATIONAL CAR AND LOCOMOTIVE BUILDER.



VOLUME XVIII. } JULY, 1887. { SINGLE NUMBERS, TEN CENTS,
NUMBER 7. } { $1.00 PER ANNUM.

Miscellaneous Items.

The Harrisburg Car Manufacturing Co. have closed a contract for building 2,000 coal cars for the Philadelphia & Reading road. The company will begin work on the contract in a week or two.

The Union Passenger Railway Co., of Richmond, Va., is laying about thirteen miles of track, on which cars are to be operated by electricity. The Sprague motor will be used, and the electric current is communicated from two pole wires overhead. An electric heater, invented by Dr. W. Leigh Burton, of Richmond, will be tried on the line, and it is claimed that it will prove very successful.

J. G. Brill & Co., of Philadelphia, have just completed four magnificent sleeping-cars. They are thoroughly equipped in every respect. The interior of the cars is finished in solid mahogany, handsomely inlaid with marquetry work. The ceilings are of bird's-eye maple and the trimmings elaborately chased nickel-platings. Attached to the car proper is a neat lavatory, furnished with all the essentials of a complete modern toilette.

The new Illinois Central bridge, across the Ohio River at Cairo, Ill., will contain two spans of 525 feet each, and seven spans of 400 feet each, with ten piers. The lumber and other material for the construction of the caissons have arrived and work on them will begin at once. The first caisson built will be placed on the Illinois side and will be 70 feet long and 30 in diameter. The foundation of the piers will be 75 feet below the zero of the water gauge and about 45 feet below the bed of the river.

The Indianapolis *Journal* says that A. M. Palmerton, inventor of the Palmerton wrecking frog, has devised a new rail which promises to be a great improvement over the ordinary "T" rail. It is really a continuous rail, and if broken into twenty pieces a train would not be thrown from the track. The wheel passes over a joint as smoothly as over any part of the rail. The expense of its manufacture will be no greater than the ordinary rail. Railroad men who have examined it pronounce it a good thing, and a device which will greatly increase the safety of travel.

A train employé of a Western railroad has been writing to the papers, saying that it costs the men about five dollars a month to subscribe for presents for the officers of the company. We believe the statement is a base slander. There is no department of industry where the tax represented by getting up presents is less in vogue than in railroad service, and if the practice happens to become very common on any particular road, the railroad press would soon get on to it, and the railroad press has always displayed uncompromising hostility to present giving on an objectionable scale.

A correspondent writes us saying that engine No. 2 on the Green Bay, Wisconsin & St. Paul road, with a straight, open stack, without extension smoke-box, cylinders 15 × 22 inches, has been making the regular run between Green Bay and Grand Rapids, with a train of two coaches, stopping twenty times during a run of 100 miles, and using only one ton of coal per trip. The division has several heavy grades. The arrangement in the smoke-box was devised by Mr. A. Fenwick, master mechanic of the road. Three passenger engines and one freight engine are equipped with the arrangement, and all give the highest satisfaction.

Master Carpenter Webb, of the Pennsylvania road, has just moved the large bridge at Johnstown, Pa., so that travel would not be interrupted during the building of the new stone arch structure that is to replace it. The work was done in 10¼ hours. It required 75 carpenters and 100 laborers to move the bridge. Not a roller was used, but the work was entirely accomplished with the aid of greased rails. The bridge is 400 ft., long. It was moved 52 ft. from its original position at the west end, and 47 ft. at the east end. The next bridge to be moved will be the one at Summer Hill, between Cresson and Johnstown. It is 278 ft. long.

Mr. James N. Lauder, of the Old Colony Railroad, is building three new 17 × 24 locomotives of the type illustrated in the NATIONAL CAR AND LOCOMOTIVE BUILDER of March last. These engines pull trains of 14 and 15 passenger cars, most of them being heavy parlor cars, at a speed of 40 miles an hour with ease and have power to spare. In a new time card recently issued, the Fall River Boat train is run through from Boston to Fall River without a stop. It was found that the tenders in use did not hold sufficient water to make the run, and Mr. Lauder succeeded in eight days in making a new tender to hold 3,500 gallons. As trucks, frame and every part of the tender had to be made in the time, and no previous notice was given of the necessity, the job was well worthy of notice.

The American Brake Co. and the Burlington Tests

AURORA, Ill., June 4, 1887.

Editors National Car and Locomotive Builder:

GENTLEMEN: In view of the early closing of the Automatic Freight Brake Tests, the American Brake Co. were unable to have any tests made with their brake. We inclose you herewith a copy of a letter which we are in receipt of to-day from them, explaining why they were delayed in getting their train ready to enter the tests at the time specified. Yours truly,

GEO. W. RHODES, *Chairman.*

ST. LOUIS, MO., May 25, 1887

G. W. Rhodes, Esq., Chairman Automatic Freight Brake Committee, Burlington, Iowa.

DEAR SIR: In response to your circular letter asking if this company would participate in the tests at Burlington, we advised you in the affirmative, fully expecting to be prepared in ample time to do so.

We purchased a train of fifty cars, and made every effort possible to have it ready in time for appearance at Burlington, but being overcrowded at our shops with regular orders to be filled for our brakes, we were forced to contract with outside shops to do a greater portion of the work, and when the brakes were set up complete on the train, and the tests made, we found that this work done on the outside was so defective as to make it impossible to complete the brakes in perfect shape in time to appear at Burlington. As we had tested our devices thoroughly and were satisfied that they were all right, we did not anticipate this drawback at the last moment in the merely mechanical work. We therefore had to abandon the idea of appearing at Burlington, but will now take the work into our own shops and hope soon to have our train in complete working order. The results of any tests will of course be made public.

We regret exceedingly not having been present, and there would have been no doubt about our participating in the tests had we not been forced by the overcrowded condition of our shops to contract outside for important mechanical work.

We desire to thank yourself and the committee for the many courtesies extended to us directly, and through our representatives. Very truly yours, S. M. DODD, *President.*

Driver-Brakes at Burlington.

We have received from the Eames Vacuum Brake Co. (123 Oliver street, Boston) the following statement of the performance of engine driver-brakes at the recent trial tests at Burlington:

Engine and Dynamometer Car. Speed, 40 miles an hour on down grade of 53 feet.

Actual stops.

	Miles.	Length of stop.
Eames	40½	922 feet.
Westinghouse	40	1,010 "
Carpenter	45	1,177 "
American	38½	880 "

Commuted to even 40 miles speed.

Eames	40	899 "
Westinghouse	40	1,010 "
Carpenter	40	931 "
American	40	961 "

The American engine was a consolidation, while the others were eight-wheel standard engines. The American engine, tender and dynamometer car weighed, substantially, 197,000 lbs.; 142,000 lbs. of which were upon the wheels to which brakes were applied, equal to 72 per cent. of the total weight. The eight-wheel engines, tender and dynamometer car weighed, substantially, 168,000 lbs.; 97,000 lbs of which were upon the wheels to which brakes were applied, equal to 58 per cent. The American engine made its stop in 961 feet, with brakes on 72 per cent. of the load. If it had been loaded to correspond with the eight-wheel engines, it would have required for this stop 1,192 feet, showing that this brake was very much less efficient than either of the other brakes.

Engine, Dynamometer Car and fifty one empty Cars. Speed, 20 miles an hour, on level. Stops made with driver and tender brakes, only.

Actual Stops.

	Miles.	Length of stop.
Eames	20¾	1,747 feet.
Westinghouse	20	2,589 "
Carpenter	22½	2,475 "

Commuted to 20 miles an hour.

Eames	20	1,625 feet.
Westinghouse	20	2,589 "
Carpenter	20	1,956 "

The Grand Army of Cranks.

A well known ex-railroad man in announcing at a meeting of a railroad club that he was interested in promoting the adoption of a patented device for making railroad travel safer than it had been, remarked that he had joined "the grand army of cranks." We confess to entertaining a warm interest and kindly admiration for the men who form the army referred to, and we have no sympathy whatever with the detractors and fault-finders who are ready to class every man as a crank who becomes strongly interested in advocating some particular device, the term implying that the man is unbalanced. Humanity has in all ages been deeply indebted to the class of men who concentrate all their energies on advocating a particular idea, and civilization has received its strongest motive power from the men who devoted their lives to forcing inventions upon an unwilling world. The man whose feelings are so keen that a breath of opposition dulls them, the man with intellect so nicely balanced that a rude word throws him into confusion, is not endowed with the faculties necessary for leading in the march of human progress. Such men never could have persisted in introducing the printing press, and thousands of other inventions scarcely less valuable to the world that inclined to receive them not. The circumstances that militated against the introduction, and raised up obstacles to the adoption of improvements in far past years, hold good with more or less force in the present day, and the railroad world would have lost many of the most valuable safety promoting and expense-reducing appliances had they not been advocated and pushed forward, in season and out of season, by men who were not discouraged by opposition, or turned from their purpose by unfair treatment. The American railroad world has paid fairly well for the use of patented devices, but nothing like what the devices have brought in returns by savings of life and property and prevention of waste. After the fact of an invention being put in successful operation, as prepared by inventors or manufacturers, there are many men ready to say that the invention might have been produced as well by railroad companies, and much outlay saved; but the mechanical departments of railroads do not have a monopoly of the inventive ability of the country, and until that condition of affairs comes round, it will be cheaper for companies to pay for inventions than to attempt raising and maintaining all the inventors needed for their own wants.

Whenever the need of some improvement to our railroad machinery becomes urgent, a whole army of inventors proceed to work out the device. No army was ever so poorly paid, but there are one or two great prizes to be won, and the hope of gaining these prizes buoys the hopes of the many. When the various inventions are brought before the railroad world, those of leading merit are quickly selected, and those who fail return to their inventive labors hoping to be more successful next time, or the representative of a device that has failed, not through lack of merit, but owing to circumstances that are not always creditable to those who have made the decision, goes about insisting that his invention ought to be chosen, and for that he is called a crank. The men who devote themselves to the improvement of certain lines of railway machinery become experts in the department of their choice, and in many instances such men are more competent to say what will work satisfactorily than the men in charge of the railway machinery of the country.

From the lowest point of the road bed to the top of the highest bridge, there is no member of the railroad structure or article of railroad machinery that is not indebted for improvement to the so-called grand army of cranks. Railroad machinery of all kinds is better adapted for the work it has to perform, safer for the transportation of passengers and freight, more economical and more durable from the work done upon it by the great army of American inventors. The independent truck, the Miller platform and coupler, the automatic air brake and all other life-saving appliances have been pushed into service by the men who were the cranks of their day and generation, if that word is going to be used towards all who are single minded believers in making things better, and in trying to teach their fellow men through the highest order of utilitarian preaching. May good fortune attend our grand army of cranks; the country would be poor indeed without them.

Master Car-Builders' Association.

TWENTY-FIRST ANNUAL CONVENTION.

Contrary to expectation, an unusually large number of members were in attendance when the convention was called to order in Curtis Hall, Minneapolis, June 14. The way some roads have strained the Interstate law to curtail transportation courtesies, and the distance of Minneapolis from the East made many believe that there would be a slim attendance, but those so impressed were pleasantly disappointed.

President Verbryck called the convention to order promptly at 10 o'clock A. M. and requested the Rev. J. H. Tuttle to open with prayer. The reverend gentleman appealed to think railroad men were badly in need of his good offices, for he supplicated on their behalf for nearly twenty minutes, and, as a lady present remarked, prayed for almost everything and everybody except his mother-in-law.

Mayor Ames, of Minneapolis, then welcomed the Association to the city in a brief and sensible address. In the course of it he said, "I want you to build cars that will not kill so many men. You in the East make cars we call out here 'bumpers.' If you would build cars which fitted our cars in the West, it would lessen my practice. I am a surgeon, and a railroad one at that, but I do not want the business these cars give me. It is terribly hard on the men who are killed and wounded."

After some routine business was disposed of, President Verbryck delivered the opening address, as follows:

PRESIDENT'S ADDRESS.

Gentlemen of the Master Car-Builders' Association:

Again we have met together to consult about the various interests committed to our charge. I think we all realize that we are benefited by the interchange of ideas at our annual convention, and that when we adjourn we go home better prepared for the duties we have to perform. The railroad interests in our country have become so vast and varied, and are becoming more and more so every year that any person who imagines he has nothing more to learn and does not keep up with the times will, to use a rather questionable expression, get badly left. A quarter of a century ago, when railroading was comparatively young and with very little interchange of traffic it was thought unnecessary for the heads of mechanical departments to go about much and get acquainted with each other; but things have been changed, and I venture to say that most of the general managers of the important lines not only see the necessity of one meeting but encourage their mechanical superintendents to attend the meetings of the Master Mechanics and Master Car-Builders' Associations. At the last annual meeting of our association I stated that the committee having the subject of Automatic Brakes for Freight Cars in charge had made arrangements for a test that gave promise of some definite conclusions. I am happy to say that an exhaustive test was made in the month of July, 1886, at Burlington, on the Chicago, Burlington & Quincy Railroad, and again in the month of May of this year, under the management of your committee and its able chairman, to whom too much praise cannot be given for the time and labor he expended to make it as fair and complete as possible. I presume he will report the result of the tests at the proper time as fully as the short time since the last tests made will allow. The Car Coupler question, I am sorry to say, has not made any advancement toward solution, and is still a perplexing subject. It would seem that among all the different types of hook, and link, and pin couplers a satisfactory coupler or couplers could be chosen that would be adopted by the principal trunk lines and be satisfactory to the Railroad Commissioners of the different States that have passed laws making the use of a safety coupler obligatory. I can not entirely agree with one of the Honorable Railroad Commissioners who has written a number of articles which were published in a railroad paper in which he charges that railway officials and directors care nothing for the life and welfare of their employes in comparison with a slight difference in the amount of the annual dividend, and that they will never put on safety appliances until they find it cheaper to do so than to pay for injuries. From personal observation on the road I represent when we have put on couplers that would couple without going between the cars by merely setting the link nine times out of ten when I have watched them unseen by the switchmen they would not take the trouble to do it, but would go between the cars to couple and guide the link with their hands. Several years ago a road that I am acquainted with issued an order that the men should use sticks to lift and guide the links, and must not go between the cars to couple, and sticks were provided for the purpose. I watched myself several days to see the order was obeyed and the sticks used. I saw when any of the officials of the road were around they would use them, but rarely when they thought they were not seen. Now I think the gentleman referred to has not had much experience with switchmen and his assertions should have been qualified. I do not think there are any persons in any kind of business that are so willing to try an appliance that appears to have merit in it and give it a fair test as railway officials. Since our last annual convention the subject of heating and lighting passenger cars has been brought prominently before the public, occasioned by several disasters during the past winter in which wrecks the cars caught fire from the stoves and lamps and a number of persons were burned to death. I don't think we can afford to ignore this subject, and hope that at least a portion of our time may be spent in discussing this important subject and a committee appointed to thoroughly investigate and report on the best and safest method of heating and lighting cars.

The rules of interchange, which were there before you at the usual time, will need some revision, as several questions have arisen during the past year in which differences of opinion were held as to the proper interpretation of some of them. These questions have been submitted to the Executive Committee, and by them decided until the annual revision takes place. They should be so worded that they can not be misunderstood. The different railway clubs have had them under discussion during the past year, and I have had no doubt that the members will be much better prepared to discuss them and suggest improvements than heretofore. Other subjects of importance will be presented by the committees having them in charge as they are called upon, but which I will not now take the time of the convention to mention.

It becomes my painful duty to announce to the association the death of Mr. Leander Garey, who so long and ably was the presiding officer of our association, which took place at his residence, Hartsdale, Westchester County, New York, Dec. 1, 1886. As my immediate predecessor, most of you were acquainted with him, and I know that members of this association will join me in expressing our deep sorrow to his bereaved family for the loss of one who by his uniform courtesy and kindly manner had won the respect and good will of all, and in extending to them our sympathy for their great loss. I have also to announce the death of the following members since our last annual convention: F. W. Frederick, M. M. Pendleton, Samuel Stevens and Lionel Lee. As the proper time committees will be appointed to prepare memorials of the deceased to be published with the annual reports.

Thanking you for your kind attention and with the hope that our sessions will be attended with the same good feeling and courtesy which have made our former conventions so pleasant and profitable to all of us, we will now proceed to business.

SECRETARY'S REPORT.

Secretary Forney next read his annual report, which showed that the association was in a prosperous condition financially, and in the increase of its membership. The Secretary expressed doubt whether a printed report of the discussions of the Rules of Interchange of Cars was worth its cost. He recommended that a pamphlet should be issued annually, giving the standards adopted by the Association. The concluding paragraph reads:

The Secretary will call attention to the present condition of admission of members of the Association. There is nothing at present of the nature of the Committee on Admissions. The consequence is that the Secretary is obliged often to exercise the perogative which ought to be in the hands of such a Committee, or else leave the doors wide open for any one who chooses to enter the Association. He would, therefore, recommend that the Constitution and By-Laws be amended so that the three senior executive members be constituted a Committee on Admission and that all applications and appointments of members be first submitted to them and that they report to the Executive Committee on the eligibility of applicants for membership and that the Executive Committee declare whether or not the applicants are eligible. As considerable amendment of the Constitution is required to make the change proposed your Secretary would suggest that a committee be appointed at this session of the Convention with instructions to submit an amendment to this meeting for action before its adjournment.

COMMITTEES.

The President nominated the following committees:

On Nominations.—Robert Miller, C. A. Smith, George Hackney, J. N. Barr, Geo. F. Wilson.

Subjects for Investigation and Discussion.—Joseph Wood, Wm. McWood, E. B. Wall.

Correspondence and Resolutions.—L. G. Matthews and J. C. Barber.

To Select a Place for the Next Annual Meeting.—W. F. Turreff, John B. Fletcher and R. H. Wilbur.

The next bussiness was the election of an Auditing Committee. The following members were nominated and elected: T. Sutherland, H. H. Perry, John Mackenzie.

ADMITTING RAILROAD COMMISSIONS.

Mr. John W. Cloud moved that members of the United States Railroad Commi-sion and the various State Railroad Commissioners be invited to participate in this and future conventions. Adopted.

STANDARD BRAKE SHOE AND HEAD.

Secretary Forney read some correspondence from Mr. W. W. Snow regarding the standard brake shoe and head adopted by the Association. One letter which fully explains the matter says:

We find upon a careful examination of this matter that there is quite a difference between the drawing, as adopted, and the large majority of Christie shoes in use. We find in our records that there are (15) fifteen roads using Christie shoes that will interchange with each other; these roads own and control 63,269 cars. The drawing as adopted by the Association agrees with *but one road* of which we have any records. This road owns and controls 6,123 cars. There may be other roads in both cases, which will increase these numbers, leaving the comparative difference the same.

We call your attention to these facts only for the purpose of considering the propriety of changing the length of the head from $12\frac{1}{4}$ to $10\frac{1}{4}$, which will be the only change from the original sketch required to make the shoes interchangeable with the 15 roads and lines we have referred to.

In connection with this matter, the Executive Committee had adopted the following resolution, on motion of Mr. F. D. Adams:

That the sub-committee be instructed to report the difficulty described by Mr. Snow to the association, with the request that the association authorize the sub-committee to examine the different Christie shoes in use and arrange the standard, so that the long shoes and short shoes will interchange with the same head.

Mr. F. D. Adams (Boston & Albany) expressed himself as being against making any change in the standards adopted by the association.

Mr. E. W. Grieves (Baltimore & Ohio), representing one of the roads that has adopted the shoe represented to be the standard of the Association, was against making a change. They had taken the engravings sent out by the M. C. B. Association, and made their patterns from the same, so they could not be expected to make another change, as changing patterns was a serious matter to a large road.

Mr. Robert Miller (Michigan Central), said they made their patterns according to the M. C. B. dimensions, and he was opposed to change.

Mr. L. Packard (New York Central) said they had 2,000 heads in use that are interchangeable with the Baltimore & Ohio shoe.

Mr. Cloud did not think it desirable to make a change in patterns unless there were some very urgent reasons for so doing. Did not see that the urgency existed in this case.

Mr. John Mackenzie (New York, Chicago & St. Louis) moved that the discussion be closed. Carried.

MEMORIAL TO LEANDER GAREY.

Mr. F. D. Adams read a resolution providing for the appointment of a committee to frame resolutions on the death of Leander Garey, to be engrossed at a cost of not more than $50, and sent to the family of the deceased. Carried.

PROPOSED CHANGE OF CONSTITUTION.

The Secretary read a recommendation of the Executive Committee, proposing to change article III., section 4, of the constitution, so that railroad commissioners might be admitted as associate members.

Mr. Adams though that if railroad commissioners were to be admitted, the clause providing for investigating into the fitness of applicants, and the provision which makes it necessary that they should be proposed by three members, should be dispensed with.

Mr. James N. Lauder (Old Colony) wanted to know how it would be when the term of office of a railroad commissioner expired. While in office the political importance and influence of railroad commissioners were great, and in every way it was desirable that these officers should be admitted to take part in the proceedings of this Association. But if they were made members for life this Association might ultimately find itself with a large contingent of political dead-beads (he meant nothing disrespectful) who would not be of any service whatever to the organization.

Mr. Cloud thought as the railroad commissioners were already invited to participate in the sessions of this and future conventions, that the privilege to be granted was sufficient.

After some further desultory conversation about it, the subject was dropped, without any vote being taken.

AUTOMATIC FREIGHT CAR BRAKES.

Mr. G. W. Rhodes, who was received with warm applause, walked up to the platform and read the report of the committee appointed to investigate this subject.

REPORT OF COMMITTEE ON FREIGHT TRAIN BRAKES.

To the Master Car-Builders' Association:

Your committee on freight train brakes completed a second series of tests on the first of this month which extended over a period of three weeks this year and four weeks in 1886. It has not been possible to have a full report of such an extended work ready for this meeting. A statement of the tests with tables, engravings and diagrams is however being compiled, and will be completed in time to be embodied in the Association's published annual report. We must ask your indulgence, therefore, if we briefly give you an account of the gradual growth of the tests and allude to some of the leading features they have brought out.

In submitting a report to the convention in 1885, the committee apologized to the Association for drawing attention to so important a question on the meager investigation they at that time had been able to make, and called attention to the fact that a complete report should be based upon an elaborate series of competitive tests. None of your committee recognized at that time that these tests, which were so indispensable to the investigation of the subject, were also within easy reach, and merely required action on their own part. This fact has an evident bearing on all investigations, and we have, therefore, alluded to it prominently. The framing of the different tests prescribed at the joint meetings which were afterward inaugurated with the representatives of the brake companies and the criticisms which have grown up from publishing the proceedings of these meetings have been equally instructive. An old member of your Association wrote regarding the competitive tests proposed for Dec. 14, 1885, that, "while not indorsing the conditions imposed, he was glad to see them published. They would provoke criticism; that out of criticism grew discussion, and from discussion we reaped progress." The fact that your committee will now be able to present results gathered from a carefully conducted series of tests is largely due to their having availed themselves of the discussions they have awakened and the assistance that has been given from outside sources.

At the convention of June, 1885, the Chairman was authorized to add three members to the original committee. From the discussion which followed the presentation of their first report it appeared desirable that the additional members should have had experience with or be disposed to advocate independent brakes which at that time were looked upon favorably by many, consequently Messrs. John S. Lentz, Master Car-Builder Lehigh Valley Railroad; W. T. Hildrup, President Harrisburg Car Manufacturing Company, and D. H. Neale, Editor *Railroad Gazette*, were added to the committee.

Your committee met at Buffalo in September, 1885, and decided that a public contest was indispensable in any further investigations. The following month, through the courtesy of the Chicago, Burlington & Quincy Railroad Co., your committee was enabled to propose a series of brake tests, the conditions of which were announced by circular Oct. 15, 1885. This proposed trial produced considerable criticism both from brake companies and members of the Association. These tests were subsequently abandoned; the correspondence they had provoked, however, enabled your committee to organize a series of joint meetings with the different brake companies, which resulted in a brake trial commencing July 13, 1886, at Burlington, Iowa.

These tests lasted until Aug. 2. There were five competitors present, the Eames automatic vacuum, the Westinghouse automatic air brake, the American buffer brake, the Rote buffer brake and the Widdifield & Button brake. The results of these early tests have been fully published; none of the competing brakes in the estimation of your committee did satisfactory work with 50-car trains, and therefore the proposed endurance tests, and the April, 1887, tests were abandoned and a new series of 1887 tests for 50-car trains only prepared, giving both old and new companies the opportunity of remedying the faults in their brakes when applied to long trains, so forcibly brought out during the 1886 tests.

The most important of these faults was the unlooked-for effect of shock in long trains, controlled with power brakes, when applied in succession from the engine, and the prominent part that the shock in the rear cars at once assumed with all the train brakes that were brought to our notice. The expected difficulties in applying and releasing continuous brakes on trains of 50 cars were shown to be no more serious than would occur with an ordinary passenger train, and the complete failure of the independent brakes was convincingly brought out.

At the May, 1887, tests five companies were represented, the Westinghouse air brake, the Eames vacuum, the Hanscom air brake, the Carpenter electro-atmospheric brake, the Card electric brake. It will be observed that only the continuous type of brake entered the contest this year. The 1886 tests had shown clearly that quick application on long trains was the only method of avoiding the shock at the rear of the train. Special attention had been given this by the competitors; even the Westinghouse and Eames companies coming in 1887 with electric appliances adapted to their brakes, through which they could obtain instantaneous application. It is a well recognized fact that there is no mechanical difficulty in getting any amount of braking power on a car; the difficulty has been in getting a quick application.

The Westinghouse Co. used 50 Pennsylvania Railroad standard 60,000 lb. cars, the average weight being 30,577 lbs., and fitted with the Janney coupler. The brakes were fitted this year with a new quick action triple valve. The first sharp reduction of air puts the triple valve nearest the engine into action, and the air it draws from the train-pipe starts the next triple, and so on throughout the entire train. The electric device used is explained in our last committee's report; it consisted of a valve which by the passage of an electric current let the air in the train-pipe escape into the atmosphere. It is not intended to use this valve on every car, but in some three or four points on a long train. Its practical effect was, instead of allowing the air to escape from the train-pipe only at the engineer's valve, it escaped at four points on the train.

The Eames Vacuum Brake Co. had 50 cars built to the Chicago, Burlington & Quincy standard for the brake company in Chicago. They have also made important changes during the past year which have greatly increased the brake's efficiency. The diaphragms and auxiliary reservoirs have been enlarged. The main improvements, however, are in the ejector, the valve, its electric attachment and the leverage. The leverage is arranged with a floating fulcrum, the effect of which is to increase the power with the travel of the diaphragm. The brake shoes being hung from the car body, their distance from the wheels is not consequently the stroke of the diaphragm is increased when the car is loaded, and the effect of the floating fulcrum is to increase the leverage when the car is loaded.

The Hanscom brake consists of an air pump for compressing air; an engineer's brake valve for the distribution of air; two lines of train pipes and a brake cylinder under each car, on which is an automatic valve for setting the brake automatically in case the train breaks in two. The brake-cylinders are made longer than the stroke of the piston, so that sufficient air remains in one end to apply the brakes in case of a train breaking in two.

The Carpenter electro-atmospheric brake was fitted to an Illinois Central engine and 50-car train, each car of 40,000 lbs. capacity, and averaging 27,351 lbs. light weight. It consists of an air pump, main reservoir, etc., on the engine and a brake cylinder and auxiliary reservoir underneath each car. The train-pipe is always in direct communication with the auxiliary reservoirs. The brake can be applied by letting the air out of the train-pipe, but it cannot be released by sending air into the train pipe. The brake can also be applied or unloaded by an electric current, which operates an electric valve on each cylinder. Another electric valve is used to release the brake.

The Card is purely an electric brake, applied to 50 Cincinnati, Hamilton & Dayton cars of 50,000 lbs. capacity, and averaging 26,000 lbs. light weight. It is fully described in the sub-committee's report. The passage of an electrical current causes two drums under each car to grip one another. One drum was constantly revolving, being driven by a chain from the axle, and the brake chain was attached to the other drum, consequently when the latter drum was made to revolve it wound up the brake chain and applied the brake. This brake required some special

arrangement on the last car of the train, an obvious objection during the introduction of the brake on any road, and in this respect differed from the other two.

The following is the report of a sub-committee composed of Mr. A. H. Bowman, Electrician, Lehigh Valley; Mr. E. M. Herr, Acting Supt. Telegraph, Chicago, Burlington & Quincy; Mr. O. E. Stewart, formerly Supt. Telegraph Chicago, Burlington & Quincy, now Superintendent of the East Iowa Division of the Chicago, Burlington & Quincy :

Report of Sub-Committee on Electric Features of Brakes.

BURLINGTON, Iowa, May 25, 1887.

Mr. Godfrey W. Rhodes, Chairman M. C. B. Brake Committee :

DEAR SIR : In pursuance with the committee's instructions in letter of May 19, we have made an investigation of the electrical appliances used by the Eames, Carpenter, Westinghouse and Card brake companies in the 1887 brake test, and respectfully submit the following report :

As to the use made of electricity we find the brakes represented naturally divide themselves into two classes, one in which electricity is entirely depended upon for the proper operation of the braking mechanism, the other in which it is used as an auxilliary or addition to a braking device complete in itself.

In the first class are found the Carpenter electro-air brake and the Card electric brake.

In the second the Westinghouse automatic air brake and the Eames automatic brake.

All the above are arranged on the open circuit system, with the exception of the Card, in which the circuit is closed, but the two batteries, one on the engine and one on the car, are so opposed to each other that in the normal condition no current passes through the train. In the open circuit system it is to be understood that unless the brakes are either being applied or released, no current is passing or being supplied by the batteries or other electro-generating devices. This is also practically true in the closed circuit system employed by the Card Brake Company.

The Carpenter Brake.

Taking up in order the four brakes examined we have first the Carpenter Electro-Air Brake. The electrical appliances used by this brake company consist of a secondary "Julien" battery of eight cells carried in a box upon the left-hand side of the engine, securely fastened to the frame and guide yoke, and two systems of electro-magnets connected in multiple arc upon the three-wire system, one set of magnets operating the admission, the other the release valves. They also exhibited a magneto machine, by means of which the brakes could be operated by the engineer independent of the battery. This machine was not properly adjusted for the work to be done on these tests and was, therefore, not used.

The connections between the wires on different cars are made automatically in coupling the brake hose by means of contact pieces in the hose coupling. These pieces are held in firm contact by a powerful spring, and are well rubbed in coupling, making a clean, firm contact. The wires are run under the bottom of the cars and through the hose to the couplings.

The resistance of each electro magnet was found to be 200 ohms, making for a 50-car train, when connected as shown, a total resistance of 4 ohms. It is worthy of note that with a battery of constant electromotive force, the resistance being increased inversely as the number of cars in the train, a constant current strength is maintained through each magnet regardless of the number of cars, making no adjustment necessary for different lengths of train.

With this arrangement of battery and resistance, considerable current is used while the circuit is closed, but as this only takes place while the pressure is either being increased or decreased in the brake cylinder, it amounts to but a small consumption of battery, even for a number of stops. Calculations show that with a 50-car train the braking force could be increased or decreased continuously for about 17 hours before the strength of the battery would be destroyed, and a proportionately longer period for a shorter train. From the way in which the circuit is run it is easily seen, that should an accident happen to any of the wires, causing a rupture at any point, the brakes between such point and the engine would be unaffected thereby, while those on the other section would of course be inoperative. This feature would enable the brakes on the forward section to be released by the engineer in case of an accidental break in the train. We found the conducting wires used fairly well insulated through out their length, except at points where connection was made between wires to valves and the main conductors. No attempt at insulating of these joints is made. Perfect insulation is of great importance in this system, for, should a cross occur between the two conductors, instead of the brakes being applied when an attempt was made to do so, the release, as well as the admission valves, would be open, and should the current be maintained the auxiliary reservoir, the train-pipe and the main reservoir would all be completely bled. Should either wire come in contact with any metallic connection, either with the train-pipe or any of the braking apparatus, or any part of the car forming metallic connection with the track, the result would be that either the admission valves would cease to operate by electricity and the brakes could not be set thereby, or being set, they could not be released, depending upon which wire was touched or grounded. Rain, sleet or snow would work very much to the disadvantage of the electric appliances of this brake if the conducting wires are not well and completely insulated. It is perhaps fair to say that this brake can be applied by allowing air to escape from the engineer's valve in case the current fails, but cannot be released except by electricity. In regard to details we found this electric appliance admirably designed and well worked out, giving, in our opinion, under ordinary circumstances, a good and reliable arrangement. The magnets and armatures are inclosed in the cast-iron cap on top of the valve, but are not within the compressed air chamber. They are separated from the rest of the valve by a heavy brass plate serving to protect the armatures from the magnetic influences of the other parts of the valve. The amount of current used on a 50-car train is about 3 ampères, with an electromotive force of 16 volts, the resistance of the circuit being about 5⅓ of 6 ohms. Fusible safety plugs are inserted in the circuit next the battery to prevent the possibility of the magnets being burned.

Card Electric Brake.

The next in order is the Card electric brake. This company uses two secondary batteries of a form devised by the inventor, Mr. Card, consisting of 15 cells each, one situated under the engineer's seat on the engine, the other on the rear car of the train, so connected as to oppose each other in such a way that no current passes under normal condition; also a system of 3 electro-magnets for each brake, connected in multiple series, together with an automatic rheostat current indicator and arrangement for cutting in and out as many cells as is desired to give the required braking force. The automatic rheostats are arranged in such a way that, should the train part at any point, the couplings for the wires being so arranged as to close the circuit on each section, thus cutting off part of the resistance before in circuit, an equal resistance would be automatically inserted at the rheostat. This maintains the current at a constant strength, no matter how many or how few cars are broken off. The brake is applied while running, by either the conductor or engineer moving a handle and thus cutting in or out some of the coils. The resistance of each magnet is low, being one ohm, making the resistance of the three used in each car ⅓ ohm when connected as shown. The total resistance of each car including wires is ½ ohm, or a total of 25 ohms for a 50-car train. Although considerable current is required for the full application of the brakes, only part of it is necessary for a partial application. The current is passing in this system while the brakes are in operation, for not only must the current pass to apply the brakes, but it must be maintained to keep them on. Calculation shows that with the battery used of a capacity of 10 ampère hours, 10 hours of the maximum application of the brake could be obtained before the battery is exhausted, and, of course, a proportionately longer period for gentler applications.

The conducting wires used by this brake company are not insulated excepting where they are fastened to the body of the car, and consist of galvanized iron wire cables ⅛ in. thick. The couplings are arranged to complete the circuit through one wire by a sliding contact piece in the center, the return current passing through the outside casing of the couplings. They are designed to pull apart at the couplings under all circumstances, for should the hose and contained wire be ruptured, the brakes on another section could be applied. The effect of a cross between the conducting wires here would be to apply the brakes throughout the train, and as no effort has been made to insulate the conducting wires, this is an accident which, in our opinion, is extremely likely to happen to either from the direct contact, or by rain, snow, sleet or other causes. The automatic rheostat is also a delicate piece of mechanism liable to get out of order, with the possible result of burning out some of the magnets, rendering the brake inoperative. The principle on which this brake is gotten up is admirable, but the mechanism employed somewhat complicated for train service.

Westinghouse Automatic Brake.

In the second division we have first the Westinghouse automatic air brake. The electric device used by this company consists essentially of a valve inserted in the the train-pipe, operated by means of compressed air, which raises a piston normally in equilibrium when its balance is destroyed by blowing off a chamber above it by means of a small valve raised from its seat by the armature of an electro-magnet. The current which energizes this magnet is produced by 6 Leclanché cells situated in the box under the engineer's seat, the current passed through a copper wire insulated with rubber insulation and run through the main pipe, the return being through the metal of the pipe itself. The wire is connected automatically in coupling the air hose by means of contact pieces in the center of the coupling, giving a firm contract with a slight rubbing between the surfaces. The magnets used are wound to a resistance of 11 ohms each, and but three being used in these tests, connected, as shown in diagram below, in multiple, the total resistance, about 3⅔ ohms for the magnets and about 2 ohms for conducting wire, is 5⅔ ohms. The battery used would suffice for a long time, as the wires are so connected to the engineer's valve that no electricity would be used except for emergency stops. The wires are carefully insulated, and being inclosed in the train-pipe are well protected from the effects of the weather. Should a metallic contact occur between the wire and the pipe, however, the result would simply be to render inoperative the electric valves, which, as before stated, are entirely auxiliary to the brake mechanism. The electric features of this brake are well worked, and, in our opinion, give a reliable and practical apparatus.

Eames Vacuum Brake.

The electric appliances to the Eames automatic vacuum brake are also auxiliary to the vacuum mechanism itself. It consists essentially of any electro-magnet inclosed in a cast-iron cap or chamber, which can be put in communication either with the vacuum of the main valve and auxiliary reservoir or with the atmosphere according as the circuit is made or broken. The current is supplied by a small dynamo having an armature 9 in. long and 3 in. in diameter; this dynamo has no governor, and is entirely beyond control and varies greatly in speed. The magnets, as is seen, are connected in series, making the total resistance equal to the sum of the resistances of the conducting wire and all the magnets, necessitating a very low resistance in the latter, ½ ohm each, and a current of considerable strength to overcome the entire resistance, which is, for a 50-car train, about 30 ohms. The conducting wire is fairly well insulated, and being run through the train-pipe is well protected except where it is connected to the spiral wire through the hose. The effect of any metallic contact between the conducting wire and the parts of the car in metallic connection with the track would be as far as the electrical attachment is concerned to cut out all brakes between the point of such contact and the rear of the train. The conductor could be hooked or detached in any way, causing a break in the circuit, the entire electric apparatus fails. No effort was made to protect the armatures from the effect of close proximity of iron in the other parts of the valve, and in several ways the details of the electric attachments might be improved. The use of the track as a return is to be deprecated on account of interruption to the current in case of insulated track sections put in block signal systems, and of draw-bridges.

It seems to us the whole question of the application of electricity to railroad braking resolves itself into three important questions:

First, can a valve mechanism be made operative by electricity which shall be permanent and practicable for railroad service, not having parts too sensitive or of too fine adjustment? We think it can. The valve construction as shown by Mr. Carpenter, the same which he used in these trials, is certainly more delicate and complicated than that of the well-known Westinghouse triple valve.

Secondly, can the electrical conducters for working these valves be so insulated and protected as to avoid short circuits and other injuries? We think they can by running the wires inside of the air pipes, where they are as little liable to derangement and injury and become as permanent and certain in their functions as any other feature of the brake mechanisms. In all the electric brakes shown, the wires are laid inside the air hose couplings, where they are fully protected, and their connections are made from car to car easily and certainly, so that this important point is so far settled as to require no further experiment.

The remaining point is the source of electromotive force.

Of the different means employed by the companies represented, the secondary battery appears the most reliable, giving a constant current at all times until discharged, recharging being a simple process which can be so methodically and practically arranged as not to interfere with the brake service, nor add materially to the expense.

If brakes worked by electricity are to come into general use, it is probable that both battery and dynamo will give way to the magneto generator, being a small machine about 18 in. square, having an easily turned crank which instantly develops the electromotive force required, so that a turn of the crank will actually apply or release the brake. One of these machines was shown us in operation upon an engine and tender brake. This apparatus may solve a most important point connected with the application of electricity to railroad brakes, inasmuch as it renders the apparatus on the locomotive independent of any special stations or round-houses or any stated period when a battery, if used, would have to be recharged.

We believe from what we have seen at the Burlington brake tests, and from a close personal examination of the several electrical arrangements for braking, that electricity properly devised and managed may be made a valuable auxilary to actuate power brakes on long trains, and their efficiency considerably increased thereby.

A. H. BOWMAN, }
E. M. HERR, } Sub. Committee.
O. E. STEWART, }

BRAKE COMMITTEE'S REPORT CONTINUED.

In addition to the tests prescribed at Pittsburgh in February, 1887, during the progress of the contest, engine tests were made, passenger train tests and old train brake tests. These will be described in our later report. For the present we have been obliged to confine ourselves to the 50-car trains.

The trials were opened May 9 by going through some necessary preliminary tests, the Westinghouse brake, May 13, commencing the general tests with a 50-car empty train. Three stops were made on level, resulting as follows:

50 WESTINGHOUSE EMPTY CAR TRAIN, 1887.
Automatic Air Brakes.

No. stop.	Speed. Miles.	Distance. Feet.	Shock. Inches.	Time. Seconds.	Equivalent distances. Miles.	
511	19½	186	103	9¾	196	....
521	19½	215	70⅝	11	233	....
522	36⅝	588	70⅝	17	....	993

These stops may be regarded as phenomenal in their shortness, which becomes all the more evident when we compare them with the best results obtained in 1886:

50 WESTINGHOUSE EMPTY CAR TRAIN, 1886.
Automatic Air Brakes.

No. stop.	Speed.	Distance.	Shock.	Time.	Equivalent distances. Miles.	
611	23.5	424	Not taken.	17⅛	367	....
611	20.3	354	"	16	340	....
622	40	922	"	22¼	....	922
612	40	927	"	23¼	....	927

The brilliancy of the record, however, was completely spoiled by the fearful shock given at the rear end, the slidometer moving, it will be observed, from 70 to 103 inches. The same train was then tested electrically, with the following results.

50 WESTINGHOUSE EMPTY CAR TRAIN, 1887.
Electric Application.

No. stop.	Speed. Miles.	Distance. Feet.	Shock. Inches.	Time. Seconds.	Equivalent distances. Miles.	
611	21½	160	None.	7	139	....
531	23	183	"	8	138	....
612	38	475	"	14¼	....	519
532	36⅝	460	"	14	....	545

Now comes the still more astonishing story. In these electrical stops the slidometer never moved, and this with the same cars, the same leverages, and the same pressures, the only difference being the time of application. Without electricity the application commenced on the rear car in from 5 to 6 seconds; with the electric application it was practically instantaneous on every car in the train.

The main results of the other 50 car trains are shown on the table accompanying this report. This table deals only with the average results made by the Carpenter, Eames and Westinghouse 50-car trains, emergency stops. It will be observed that the Eames is the only train going through all the tests prescribed both with its atmospheric and electric appliance. The results achieved by the Hanscom and Card brakes are not given, as their cars were withdrawn early in the trial, but they will be considered in our complete report. This table shows the average results obtained by each class of brakes in five different classes of stops, and at two speeds for each class of stop. The classes of stops are as follows:

1. 50 empty cars, brakes applied by air.
2. 50 empty cars, brakes applied by electricity.
3. 50 mixed cars, brakes applied by electricity.
4. 50 loaded cars with slack shoes, brakes applied by electricity.
5. 50 mixed cars, brakes applied by air.

The table shows the number of each individual stop from which the average is compiled, the name of the brake, the distance in which the stop was made, corrected for uniform speed, which is also given on level and grade; the time in which the brakes became fully applied and in which they were released is also given. The weight of the train in tons of 2,000 lbs., and the percentage of that weight which was braked is given, and the pressures. The movement of the slidometer indicates the severity of the shock experienced in the rear car: shocks above 12 inches are considered as objectionable, and likely to injure live stock and many classes of freight. It may be noted that the Westinghouse train was equipped with the Janney coupler; owing to the severity of the shocks, two of these were broken during the trials. The Eames train was equipped with the Boston, which is of the vertical plane also; two of these couplers were also broken during these trials. The Carpenter train was equipped with the ordinary link and pin draw-bar, which was not wedged up during the great majority of the trials and suffered no damage. The casualties due to the continuous brakes were inconsiderable as compared with last year, and show in the strongest possible way the benefits that may be obtained in freight train service by more efficient brakes, together with the elimination of the slack from the couplings.

THE RESISTANCE OF TRAINS.

The following figures give briefly the results of the No. 7 special tests made to determine the frictional resistances of the various trains. The trains were composed of 49 or 50 empty cars with dynamometer and way car and American type engine and tender. The track and rails were in good condition and the wind light.

Each train was tried once on a slightly descending tangent, and once on a curve, situated on an average descending grade of 50.6 ft. per mile. The resistance was ascertained on the tangent by running up to stop-post No. 1 at about 20 miles per hour and then shutting off steam and allowing the train to run until it came to a standstill. The resistance on the combined grade and curve was ascertained by running the train up to stop-post No. 3 at a low speed (about 5 miles per hour), and then shutting off steam and allowing the train to run until stop-post No. 4 was reached. The speed at the moment of passing each stop-post was carefully noted. It will thus be seen that the resistances given below include, not only the resistance of the cars, but of the engine running without steam. This is probably greater per ton than that of the cars, but the weight of the engine (about 40 tons) is so insignificant in comparison with that of the cars (700 to 800 tons) that the influence of the engine in running without steam may be neglected, and the resistances given may probably be taken to represent fairly the resistance of new empty cars.

1887.

Pattern of cars.	Brake.	Tangent: Speed per hour. Average. Miles.	Mean. Miles.	Resistance per ton of 2,000 lbs. Pounds.
Pennsylvania	Westinghouse.	15	15	5.87
Illinois Central	Carpenter.	14½	15	6.22
C., B. & Q.	Eames.	11½	14¼	7.51
St. Jo. & St. L.	Hanscom.	11½	15	12.00
Average		13¼	15	7.90

Pattern of cars.	Brake.	Curve: Speed per hour. Average. Miles.	Mean. Miles.	Resistance per ton of 2,000 lbs. Pounds.
Pennsylvania	Westinghouse.	19	23¼	8.72
Illinois Central	Carpenter.	15¾	22¼	9.00
C., B. & Q.	Eames.	13¾	20	11.00
St. Jo. & St. L.	Hanscom.	4	4	19.80
Average		10¾	22	9.60

In making this average, the Hanscom results on the curve are excluded, as they are not based on sufficient data to be trustworthy. The "mean speed" is the average of the squares of the speeds.

The cars were new, and were tried empty. The Pennsylvania cars were lubricated with dope. The Eames cars when loaded, after these trials, gave trouble from hot boxes. The great resistance of the Hanscom train was caused by the brake-shoes binding on the wheels. The brake-shoes on the Eames train were also in some cases very close to the wheels and apparently affected the friction of the train on the curve. The brake-shoes on the Westinghouse train were hung inside; all the others were hung outside the wheels.

The trials on the curve were made between stop-posts 3 and 4. About half the total distance is on a 2 degree 40 minute curve (2,149 ft. radius), extending over nearly a quarter of a circle (80 deg. 40 ft. 10 sec.), and the remainder of the distance is on curves a little more than half one degree, or say about 6,000 ft. radius.

The results given in similar trials of brake trains over the same ground in 1886 were as follows; the trains were, however, composed of 25 cars, 12 loaded to their full capacity and 13 empty:

(See table, next page.)

The committee are indebted to Mr. A. M. Wellington for the calculations giving the results of the trials in 1886.

The results for the two years agree fairly well. The average difference between the resistances on the tangent and on the curve was 1.84 lbs. in 1886 and 1.70 lbs. in 1887. One train of cars (Westinghouse, 1886) gave a resistance of only 4.382 lbs. on the tangent, while another train (Hanscom, 1887) had a resistance 12.00 lbs. per ton, on the tangent, or nearly three times that of the Chicago, Burlington & Quincy cars in the lighter running train. This difference was apparently principally due to the

1886.

Pattern of Car.	Brake.	Tangent. Average speed	Tangent. Resistance per ton of 2,000 lbs.	Curve. Average speed.	Curve. Resistance per ton of 2,000 lbs.
		Miles p. hour.	Lbs	Miles p. hour	Lbs.
C., B. & Q.	Westinghouse	20⅝	4.72	20¾	6.67
L., D. & S.	Eames	16¾	6.84	21⅜	9.42
Lehigh Valley	Widdifield & B	16¾	6.84	21¾	9 42
St. Louis & S. F.	American	11½	8.50	21¾	8.04
Average 1886		16¼	6.62	22¾	8 46
Average 1887		13¾	7.90	16¾	9 60
Av. of both years		14¾	7.26	19½	9.03

brake-shoes rubbing against the wheels, and was equal to a constant grade against the train of 20 ft. per mile. In running from New York to Chicago, 1,000 miles, the extra resistance would be thus equivalent to surmounting an elevation of 20,000 ft., or more than the height of the highest mountain in North America. The importance of keeping the brake-shoes clear of the wheels is thus very evident. In the 1886 trials the Chicago, Burlington & Quincy, the Indianapolis, Decatur & Springnield, and the Lehigh Valley trains were composed of cars that had been running some time. The St. Louis & San Francisco cars were new. The Chicago, Burlington & Quincy cars (Westinghouse) had the brakes hung from the trucks and inside the wheels. All the other cars had the brake-shoes hung outside from the body. The following figures, based on the average results obtained in 1886 and 1887, show the increased friction on the curve as compared with the tangent:

	Increase lbs. per ton.
Shoes hung from the truck and inside the wheels	2.30
Shoes hung from the body and outside the wheels	2.84

These results tend to show that the resistance on curves is increased considerably when the shoes are hung outside and too close to the wheels. When the truck swivels, the shoes, being hung from the body, are lifted and brought closer to the wheels by the greater inclination of the hangers. When the shoes are hung from the trucks, no such action occurs, and the shoes remain the same distance from the wheels, whether the car is running on a tangent or on a curve. The fact that outside-hung shoes rub more forcibly against the wheels on curves, is not only shown by the figures given above, but was also observed when the trial trains were being hauled over frogs and curves in the yard at West Burlington.

The size of journal bearing has doubtless an important influence on the friction of trains, and the subjoined figures give the sizes of the journals in three of the trains tried at the 1887 tests, together with the weight of each car, empty and loaded to its full marked capacity, and the resultant load per square inch on the journals. The bearing area of the journal is assumed as the length and diameter multiplied together.

Cars.	Journal length and diam. Inches.	Weight of car—Empty. Lbs.	Weight of car—Loaded. Lbs.	Pressure per sq. in. on journal. Empty Lbs.	Pressure per sq. in. on journal. Loaded. Lbs.	Friction per cent Lbs.
Pennsylvania	8 × 4	30,577	90,577	119	354	5 87
Illinois Central	7 × 4	27,351	67,351	122	301	6.22
C., B. & Q.	7 × 3¾	25,509	65,509	121	312	7.51

As the frictional resistance given was obtained with empty cars, where the load per square inch on the journal is practically identical, the variation found in the resistance is due to other causes than insufficient bearing surface. The highest amount of friction was shown in 1887 by the Chicago, Burlington & Quincy cars, while in 1886 showed the least. In both years the cars were of the same design, but in 1887 the cars were new, whereas in 1886 they had run over 10,000 miles. The difference was, therefore, probably due to less accurate fitting and workmanship, as compared with the Pennsylvania and Illinois Central cars, which were also new, but showed respectively 1.64 and 1.29 lbs. per ton less friction than the Chicago, Burlington & Quincy cars. These differences, insignificant as they may appear, would, in running 1,000 miles, necessitate an extra amount of haulage power equivalent to surmounting summits 4,330 and 3,415 ft. high respectively, or greater than that of any line between the Mississippi and the Atlantic. The importance of good fitting is further shown by the Chicago, Burlington & Quincy cars running hot when loaded after the resistance tests. The Pennsylvania and Illinois Central cars were built at the companies' shops, and the Chicago, Burlington & Quincy cars were built by a contractor.

Your committee believe from these experiments that the following figures represent the fractional resistance of long trains of freight cars in good repair running over a track in good condition, the weather being fine and warm and the wind light. The resistance appears to be constant at speeds of from 12 to 25 miles per hour, and does not appreciably increase with an increase of speed within these limits.

FRICTIONAL RESISTANCE, POUNDS PER TON OF 2,000 LBS.

Speed 12 to 25 miles per hour.

	New cars. Lbs.	Old cars. Lbs.
On tangent	8.00	6.00
On 3 degree curve	10 50	8.30

Good lubrication and carefully fitted boxes and journals may, with cars that have been running some time, decrease this resistance to a minimum of 4 lbs. per ton on the tangent, while brake-shoes rubbing against the wheels and other unfavorable conditions may increase the friction on the tangent to 12 lbs. per ton, and to considerably more on curves. The use of outside hung shoes seems to increase the resistance on curves when the shoes are very near the wheels.

The table shows the average results obtained, first with 50 empty cars stopped by air, by Westinghouse and Eames brakes.

The stops made by the Westinghouse have been already alluded to. The shocks with the Eames brake were considerably less than with the Westinghouse, but amounted to a maximum of 24 inches.

The next series of stops are those made with a train of 50 empty cars, the valves being actuated by electricity.

All three brakes participated in this class of stop.

The results are noticeable for the complete absence of shock and for the remarkably small distance in which the Carpenter and Westinghouse trains were stopped. The release with the Carpenter train, being effected by electricity, was remarkably quick, not exceeding 1½ seconds; while the Westinghouse, actuated by air averaged 36 seconds. The Eames release was in considerably less time than the Westinghouse.

The next series of tests shown in the table are those made with a train of 50 cars—33 loaded and 17 empty.

Here again the Carpenter and Westinghouse brakes showed most remarkable results. The trains weighing from 1,500 to 1,600 tons and 2,000 ft. in length were stopped in from 140 to 189 ft. on a level grade at 20 miles an hour. These stops were not accompanied by any excessive sliding of wheels and by very small movement of the slidometer, not exceeding ¾ in. The Eames brake in these stops stopped the loaded train in a shorter distance than it stopped the empty train, showing that their method of varying leverage increasing with a loaded car, produced a decidedly good effect in shortening the stop. The Carpenter and Westinghouse stops also show a slight improvement, but this was probably due to increased pressure, and in the car of the Westinghouse to increased leverage.

With the Eames trains the pressures cannot be increased, and the levers were unaltered during the trials.

The Carpenter brake would probably have shown even shorter stops had a larger pump and larger train-pipe been used, but the size of the pipe, ⅝ of an in., was insufficient to properly recharge the reservoir at the rear end of so long a train, making 4 emergency stops in 7 miles.

Trials were then made with a train of 33 loaded and 17 empty cars with the brake-shoes placed ⅛ in. clear of the wheels.

The Carpenter brake made the most remarkable showing, the average distance in which the train stopped at a speed of 30 miles per hour on a level was 334 ft., the wheels on the empty cars w re slid on an average 175 ft. and there was a slight shock in the rear end never amounting to more than 3½ in. The results obtained with the Westinghouse brake were very similar to those when the shoes were the ordinary distance from the wheels, and there was no shock.

The stop with slack shoes was made with the two former brakes with electric application. The Eames stops with slack shoes were made by air, and the results are almost identical with those obtained under similar circumstances, but with the shoes the ordinary distance from the wheels the shock was moderate, never exceeding 7⅝ in., and the wheels slid about 400 ft. on the empty cars.

Conclusion.

At the conclusion of the 1886 trials the committee felt that to sum up any results on the face of so large a field for improvement could not but be unsatisfactory, and while a wonderful advance has been made in the brake problem, as will be seen by a comparison of the stops of each year, the 1887 tests apparently leave the field for improvement open as wide as in 1886.

The Widdifield & Button and the Rote buffer brakes, hopeful over the shocks given by the atmospheric brakes, are fitting up or have fitted trains to persue their investigations. The Westinghouse Brake Company, loath to accept the teachings of 1887, is making changes in valves and piping by which it hopes to make short 50-car emergency stops without objectionable shocks and without the aid of electricity. The American Brake Company, convinced that Buffer brakes cannot compete with the continuous, is about testing a 50-car train fitted with a new electro atmospheric brake. While we are not prepared to make any definite recommendation at this writing as to what freight train brake should be generally adopted, our present information, derived from the recent tests, point to two conclusions:

First, that the best type of brake for long freight trains is one operated by air and in which the valves are actuated by electricity.

Second, that this type of brake possesses four distinct advantages:

It stops the train in the shortest possible distance.

It abolishes shock and its attending damages to equipment.

It releases instantaneously.

It can be graduated perfectly.

The further question as to whether electricity is a sufficiently reliable element to use in freight train service is one that can only be determined by experiment, but we think the benefits derived from electricity are so manifest that the experiment is well worth trying.

In view of the foregoing and of the improvements that the buffer and atmospheric brakes are making, your committee recommends that the subject of automatic freight train brakes be continued for further investigation.

GODFREY W. RHODES,
BENJAMIN WELCH,
GEO. HACKNEY,
JOHN S. LENTZ,
W. T. HILDRUP,
D. H. NEALE,
Committee.

Mr. E. B. Wall moved that the committee's report of progress be received, that the committee be continued and that it receive the highest commendation of this Association for the manner in which it is conducting its investigations. Carried.

Mr. Cloud asked if the Westinghouse brake as now in the market could be fitted to trains and have the electrical appliance put on at a later date; and whether or not the Carpenter brake could be used without electrical appliances.

Mr. Rhodes answered that the Westinghouse brake, as now on the market, could be operated without electricity, and that with the Carpenter brake the use of electricity was indispensable. These were the relative conditions of the two brakes as tested by the committee at Burlington.

Mr. Wm. Forsyth moved that Mr. Carpenter be granted permission to explain to the meeting what the possibilities of his brake were.

The President read from the constitution the clause which provides that "patentees or their agents" can not appear on the floor of the convention to advocate their devices except by the unanimous consent of the meeting.

Mr. Rhodes expressed himself opposed to the motion. If Mr. Carpenter was given permission to address the meeting, it would only be fair to permit representatives of the other brake companies to do the same, and it was not advisable that a discussion of that kind should be permitted. Motion was lost.

FREIGHT CAR PLATFORMS.

Mr. E. B. Wall represented the committee on this subject, and when the report was called he explained that no report had been prepared. The matter, he considered, had been very exhaustively treated before, and he did not see that the committee could say any thing more of importance upon the subject.

Mr. Forney moved that the "Exhaustive Committee" be discharged, which was agreed to.

Owing to delay in getting the reports printed that came next in order, Mr. Forney suggested, and it was agreed, that Mr. Wall read the

REPORT OF THE EXECUTIVE COMMITTEE ON AUTOMATIC FREIGHT CAR COUPLERS.

Your committee is prepared to make a final report on automatic freight car couplers. In order that all the reasons which have led to their conclusions may be brought before you, and in order that our superintendents, managers and presidents vitally interested in this question may thoroughly understand and appreciate the results of our conclusions, we will review the course which the Master Car-Builders' Association has followed with this problem, endeavoring to divest the report of such technicalities as might encumber its meaning with our superior officers.

The Master Car-Builders' Association has been criticized by the technical papers and by the coupler men on account of the time it has spent in the consideration of this subject, but we think it will be apparent that this time has been well spent, and that the disastrous mistakes would have been made if a solution of the question had been attempted before we had the information now at our hand. The question is certainly the knottiest mechanical problem that has ever been presented to the railroads collectively. Over four thousand attempted solutions have been recorded by individuals in the Patent Office, and one of the great complications of the problem is evidenced by the fact that the difficulty has not been to find the best coupler from a large number of meritorious devices, as might reasonably be supposed from experience with other invention made in such vast numbers, but to find even one device which did not possess grave disadvantages. The question of strength alone has necessitated metallurgical investigations of the most searching character, and we would not be surprised if it ultimately required the invention of an entirely new material. The conditions of the problem have been greatly changed since its inception by the increase in weight of cars and locomotives, the length of trains and the speeds at which they are scheduled. Opinion has altered with these changes, and automatic couplers are no longer expected to cost the same or less than bulldozes. Railroads are prepared to pay for improvements that cut down their operating expenses.

The State legislatures have attempted in several States solutions of the problem, but their action, while prompted by the most humane intentions, has really increased the complications, for they have opened the door for many varying kinds of couplers to get into service with a certain official recognition, and trainmen, unable to keep pace with all of the details of operation of the thirty-four couplers thus far so approved, are more liable to personal injury when these patent couplers are brought together miscellaneously, than with the link and pin device.

The question is national, not local, and cannot be satisfactorily solved by independent State laws; the drift of State legislation at the present time is, however, more favorable to an effective solution, and entirely in accord with the recommendation which we propose to make; this tendency is not to specify the kind of coupler, leaving that to the railroad companies, but to require that on and after a certain date the railroad companies shall equip their cars with an automatic freight coupler.

The advance of the Master Car-Builders' Association towards a solution of the problem has been in accordance with the doctrine of evolution; for many years devices have been examined, and in many cases tried as fast as they were developed; the conditions that a coupler should fulfill, and the principles upon which the various forms should operate, have been adduced to you. In September, 1885, forty-two couplers were tested at Buffalo; the requirements of the test were such that the forty-two tested represented but a very small proportion of the actual amount considered. There were in existence at that time some 3,100 patents for car couplers. The requirements were that the coupler should be placed on both ends of two cars and that the cars should be forced together to the place of tests free of charge to the Master Car-Builders' Association. It was therefore necessary that the owner of the coupler should be possessed of sufficient capital to permit him to go to this expense, or friends or capitalists who would come to his assistance, or railroad companies who considered that the device had sufficient merit to warrant them in assuming the expense. These requirements brought to the assistance of the Executive Committe the skill and intelligence of many of the members of the association, who prevented couplers obviously devoid of merit from being attached to cars.

The tests permitted a classification of the different devices then in existence, and the consideration of the couplers by classes. On investigation, it was found wise to eliminate certain classes entirely, because they involved difficulties in operation peculiar to themselves, while they did not accomplish advantages not found in other more meritorious classes. Representative couplers of the chosen classes were put on special trial, and railroad companies were further recommended to experiment for themselves with these representative couplers. These tests and this method of procedure were important steps in the evolution of the subject, because they raised the question from the endeavor to select one coupler from the great number in existence to a selection of types, as these classes virtually corresponded to types. This advance was very important, because it permits the various railroad companies a range in the selection of what coupler they will adopt, in the event of the type being approved by this association; because it enables inventors to concentrate their abilities on increasing the number of couplers in the preferred type, and devise improvements in those already in existence. It protects railroad companies against extortion, as would be the case if any one coupler, instead of a type of couplers, interchangeable among themselves, was the standard of this association.

At the close of the last convention, your association had before it the consideration of two general types of couplers, loose links, and hooks coupling in a vertical plane: the loose links represented being the Ames, Archer, Gifford, Marks, McKeen and Perry; the hooks being the Cowell, Dowling, Hein, Janney, Thurmond and Titus & Bossinger, with the special recommendation to confine experimentation to the Ames, Archer, Marks and McKeen, and the Cowell, Dowling, Janney and Thurmond. The great and important question is still then to be solved, in deciding between the relative merits of the two types, loose links and hooks, was the value of slack; whether a train could be started with equal facility with close coupling or loose links; whether the damage in starting and stopping trains, and at sags and hollows incident to loose slack, could be overcome; whether the slack, due to the presence of loose links, would interfere with the use of train brakes.

By far the most valuable contribution to the solution of these questions, made during the past year, has been in the discoveries and discussions of the results of the Burlington Brake Trials. Your association is indebted not only to the Brake Committee and its able chairman for the information given us in train braking, but for the light that has been thrown on the effect of slack as determined in the brake trials proper, and subsequent trials made specially for the purpose.

It has long been thought absolutely necessary that there should be a considerable amount of loose slack in the coupling of cars, to enable the starting of trains, and while it has been tacitly admitted that there were some disadvantages incident to the presence of this slack, due to its tendency to break draw-bars and draft rigging in starting and stopping of trains, and in pulling through sags and hollows in the track. It was never realized what an enormous evil the presence of this slack became on long trains until these trials were made. It was then found that the shocks were so terrific that it was absolutely necessary to block the links; without blocking it was impossible to live in the rear cars; stock could not stand on their feet in such a train, or freight be prevented from shifting except in the case where brakes were applied to each car by electricity. There was only one train-brake present wherein the brakes were applied in this way, and even with this brake it was found necessary to block the links in making the breakaway tests, as it was then impossible to use electricity on the rear portion of the train. At best this special train could not be considered as representing the usual conditions of service, because the cars were all of one standard, and were all new and in perfect order. If the train had been made up miscellaneously of home and foreign, and old and new cars, as is usual in service: it is fair to assume that the absence of shocks would not have been so apparent. The tests, therefore, conclusively show that power train brakes can not be successfully introduced unless close couplings are used, except in the one case where they are applied electrically to every car in the train and no breakaways are expected. The presence of loose slack having been found to be so dangerous at Burlington, the Brake Committee determined to dispense with it, in so far as possible, in making their tests. Before doing so they ascertained by actual experiment whether its substitution by spring slack would prevent the starting of an equal number of cars, as was generally believed. In this special test they demonstrated that they severest pull on the engine comes immediately after all the cars in the train have been started, and that an engine will start more cars than it can pull; loose slack and spring slack were both shown to assist in moving the train for the first few feet, but the heavy pull on the engine comes after the slack is all out. In this test they found that there was very little difference between the ability of an engine to start a train with loose links or links blocked. Going up a grade of 53 ft. to the mile with close couplings, it was found that a train could be started with greater ease with the links blocked than with the links loose; this was due to the fact that with the loose coupled train, the engine would have had to start up cautiously, in order to prevent the train from breaking in two from the jerks that would follow before all of the slack was taken up. With a close coupled train this care was not necessary, there being no loose slack, and it was possible to start with a wide open throttle. It was also found that the riding of the train was very much improved by the close coupling, as might have been expected from our experience with passenger cars. It should be remarked here, that no form of couplings, loose or closed,

entirely abolished shocks of stopping by train brakes, unless they are electrically applied, but that closed couplings are vastly more advantageous than loose couplings; they cushion the shock, and prevent the sharp and distinct blows found with open couplings. A complete elimination of shocks is a question of brakes, not of couplers.

We have now therefore reached the point in the solution of the problem where we can say that the question which presented itself at this time last year with reference to the value of slack has been decided, and that consequently the choice for this association to make is again narrowed down by a great step from between the loose link and the hooks coupling vertically to the best subtypes of the hooks.

Of the hooks before you for consideration there are the Cowell, Dowling, Janney and Thurmond specially recommended by the association, and the Barnes, Boston, Browning, Hein and Lorraine, which should be included in a report of this character. Four of these couplers, the Janney, Dowling, Thurmond and Barnes, are all of the same general type, the Thurmond and Dowling couple interchangeably with the Janney, and the Barnes, it is claimed (and we believe), can be made to do the same. The Cowell, Boston, Browning, Hein and Lorraine are all independent couplers, and will not couple automatically with any other form of coupler, except in the case of the Cowell, which will couple with the Miller passenger coupler. The Hein is of the same general type as the Janney, excepting that it couples to the left instead of to the right, and thus far its owners have not complied with the recommendation of your committee to change it, so as to couple with the Janney type. These couplers can therefore be classified under the head of Janney type, Cowell or Miller type and miscellaneous. The adoption throughout the United States and Canada of any single individual coupler which would not interchange with any others, we should consider most disadvantageous, for the reasons previously set forth; and we could not your committee recommend any one coupler as the best, and we further think it would be impossible for the railroads to agree upon one coupler.

The Cowell coupler is an ingenious device upon which much labor and money have been expended. It has been materially benefited by the skill and ability of members of this association, who have experimented with it, but it has not been made sufficiently strong to resist even the ordinary shocks of service; its deficiencies have been pointed out to the owners, and they have to not been able to remedy them. Another objection is that the Cowell coupler, in so far as freight is concerned, is an independent coupler which does not automatically couple with any other device.

The Janney type of coupler, including the Janney, Dowling, Thurmond, and, we think ultimately, the Barnes and Hein, is the type to which the evolution of the subject has brought us; it affords a close coupling with spring slack; it makes it possible to use power train brakes; it already includes several couplers and opens the door to more, so that no railroad company is restricted to purchasing from one manufacturer; it incorporates more of the practical requirements of a perfect automatic train connection than any other type or form of coupling. It is not a new, unknown and untried coupler; it has been used in the Janney form very extensively on some of our largest roads in the North and West, and in the Thurmond form in the South. Its most serious defect is in strength, and the question that now presents itself is, "Can this defect be remedied?" We consider that it is remediable, and the further development of the problem must be in this direction; and what we say here on the subject of strength is applicable to all forms of couplers, no matter of what type. This development can be accomplished by following three paths:

First: Increase the dimensions.

Second: Improve the character of the material.

Third: Protect the coupler by dead-woods, or better still, spring buffers.

The development in the line of the first path must stop before interchangeability is destroyed; this limit, except possibly in some minor details, has practically been reached. In the second path much remains to be done; its advance has already been marked by transitions from cast to malleable and wrought iron, in some cases from malleable iron to cast steel. Experiments are now being made on a large scale with manganese steel, and we are hopeful that the general attention being given to the improvement of the material will result in valuable discoveries. The third path, protection, promises the most important benefits, although we believe all three paths should be followed. It is daily becoming more apparent that we cannot consistently expect the small detail parts of a coupler to act as a buffer between such ponderous bodies as heavily loaded freight cars brought into sudden conjunction. Though these parts are designed to operate together in forming a coupling, they cannot successfully perform this function in a satisfactory manner and be the first to receive the whole force of the blows of service. These shocks should be received immediately upon that portion of the car strongest to resist them—the end sills, backed by all the floor framing in the car. Another line of development which should be mentioned here is the simplifying and standardizing of the lever-, rods and chains used for operating the various forms of couplers.

The committee feels that the status of the problem at the present time as here stated, warrants them in making the recommendation that this association adopt as a standard form of coupling the Janney type of coupler; that the association procure one of the present makes of Janney type of coupler, selection being made by a committee appointed for that purpose, and then all other forms of couplers that will couple to and with this coupler under all conditions of service are to be considered as within the Janney type, and conforming to the standard of this association. Your committee trust that you will see fit to submit this recommendation to letter ballot. We make it with a full appreciation of the gravity of the situation. We have, as our present and previous reports we trust will show, approached this conclusion with great consideration, and we believe that no other conclusion would be in harmony with the facts.

Our study has been based purely on the mechanical features of the problem, although we have not hesitated to consider and point out incidental advantages, not mechanical, that would result from the adoption of the Janney type. We believe that the office of this association and of its members is with the mechanical department of railroading, and that what our railroads want and look to us for, is a statement of what type of coupler best fulfills the mechanical condition of a perfect train connection. When we have done this we have performed our duty, and to our superior officers belongs the question of negotiation for the use of the couplers. If you approve the recommendation of your committee, you give the railroads the type of coupler which meets more of the requisites than any other type or form: it is a type capable of fundamental duplications, already duplicated successfully, so that there is now, and we believe there will be still more, opportunity for selection between several different forms of the same type.

There is an urgent necessity that the association should act at this time, either in the line that your committee has recommended or in some other. Railroads have reached a point where there is an absolute need for an automatic train coupler; it is vividly apparent that a coupler must be introduced to save the life and limb of the employé, decrease the cost of operation by enabling the use of power train brakes, to do away with the shocks of stopping and starting and to eliminate the damages of bunching trains in sags and hollows. The public demands it, the safety of the trainmen demands it, and the economical operation of railroads demands it. Already several corporations are acting, and more, some of them very large, are getting ready to act this year; the urgency is great, and will not brook delay. If we do not agree upon some coupler we shall be reprehensible, for it is only by this association that uniformity can be established so that all of the lives and limbs which it is possible to save will be saved; that all of the benefits in operation that it is possible to achieve will be achieved. If we do not secure this uniformity, who will be responsible for the extra risk which comes to trainmen when two odd couplers on a home and foreign car are brought in conjunction? Who will be responsible for the extra cost of operation that such a condition will entail? This association. The fruit is now ripe, and if you do not pick it it will be spoiled for next year. Numberless complications arising from the introduction of miscellaneous couplers will leave this association in a mess from which we shall never be able to rise, and our opportunity to serve our fellow men and our companies will be irrevocably lost.

In view of the fact already mentioned, that the best type of coupler is undergoing development in matters of strength and simplicity, and that many railroads are not ready to adopt it until it is better perfected, your committee would further recommend the continuance of the use of the Marks, Ames and McKeen couplers as the best representatives of the loose coupler.

B. K. VERBRYCK,
JNO. W. CLOUD,
E. W. GRIEVES,
JOHN KIRBY,
F. D. ADAMS,
R. C. BLACKBALL,
JOHN S. LENTZ,
E. B. WALL,
Executive Committee.

When the reading of the report was concluded, a motion was carried that the consideration of the report be postponed to the following session. The meeting then adjourned for the day.

SECOND DAY'S PROCEEDINGS.

The greater part of the day was devoted to discussing the Rules of Interchange of Cars.

DISCUSSING THE CAR COUPLER REPORT.

Mr. Cloud moved that the report of the Committee on Car Couplers be accepted and their recommendations sent to letter ballot.

Mr. Adams moved that the meeting adjourn, which was lost.

Mr. Rhodes strongly objected to any attempt being made to defer action on the report of this committee. There were many reasons why the recommendations of the committee should be adopted, The subject, wide as it is, has been thoroughly discussed, and the time is now come for action. The brake tests at Burlington, and other tests carried out by the Chicago, Burlington & Quincy road, threw much new light on the matter of coupling trains. In the course of tests they made with close couplers, the engineers were surprised at the smooth way trains could be handled, and at the freedom from breakage under circumstances that would break links, pins and pull out draw-bars when loose couplers were used. They found close couplers of so much benefit in the handling of trains that their superintendents had adopted the practice of wedging up the slack in through trains, and they were now handled as smoothly as passenger trains.

Mr. Miller thought the report of the committee indicated that progress had been made and believed the action taken would help to settle the question. The testimony given by the committee about the Janney coupler did not agree with his experience. He thought it had failed as often as any coupler of the type to which it belonged. He was opposed to any action tending to push the Janney ahead of others with as great or greater merits. The State of Michigan prohibited the use of the Janney coupler. He believed the Cowell, the Titus & Bossinger and others to be better than the Janney and hoped such couplers would be added to the list. When all the couplers came to be tested thoroughly the survival of the fittest would bring about the final decision.

Mr. Cloud suggested that Mr. Coffin, Railroad Commissioner of Iowa, be invited to speak on the question.

The Secretary read a letter from Mr. G. C. Watrous testifying strongly in favor of the Cowell coupler, and expressing the hope that it would be selected.

Commissioner Coffin said the only feature of a coupler he was looking after, was one that would provide for the safety of trainmen. He cared not a copper what coupler or type the association recommended or railroads adopted, so long as it proves safe to the men who handle trains. He had read the report and could not express the satisfaction it gave him to read it. It seemed to be opening the dawn of the time when the thousands of trainmen who are now slaughtered in coupling cars will be saved. It seemed that this most influential association was going to reach a great decision that would result in saving a multitude of lives. Do you realize that since this committee was appointed, one thousand young men have been slaughtered by this most terrible link and pin coupler? There is a fearful responsibility on this body in this matter. I am here appealing for the men who cannot appeal for themselves. He went on contending that the trainmen whom the president blamed for not using sticks, or other safety methods of coupling cars, were not to blame for the apparent recklessness. It was the system which was to blame, that encouraged them to feel a pride in taking chances that frequently proved fatal. He held that it was as much the duty of railroad companies to take these temptations away as to provide other safeguards against men putting themselves into danger. He had been a farmer all his life, and well remembered when they reaped their crops with the sickle. Then came the cradle, which was quite an improvement. After that came the reaping machine, which was a greater improvement; and still later came the Marsh harvester, which was a wonderful boon to the farmer. Now, what would you have thought of us farmers if we had refused to take any of the improvements as they came up, on the plea that they were not perfect enough, and that something better would be brought out by and by? Yet that has been the position of railroad companies and the master car-builders in regard to car couplers. It is an urgent duty on the part of the association to do something.

Mr. Cloud wished to remind gentlemen of the association before voting, that this is merely an expression of their opinion as to what type of coupler is best, leaving railroad companies to work out the details as to interchangeability. He contended that railroad companies had been doing all in their power to prevent loss of life. He believed that the action of State legislatures in prescribing certain couplers was causing increase of danger to trainmen instead of promoting safety.

The motion was finally carried, and the recommendations of the committee sent to letter ballot.

THIRD DAY'S PROCEEDINGS.

The first order this morning was to discuss the subject of Car Heating. When the subject was announced, no one had anything to say about it, and the next order of business was proceeded with. Mr. Forney read the following paper on

ACCIDENTS TO TRAINMEN.

To the Master Car-Builders' Association:

At each annual convention of this association for a number of years past a committee has been appointed to make a report on accidents to trainmen. At successive meetings various excuses have been made by such committees for not presenting reports on this important subject. Within a few weeks of the date of the meeting of this annual convention, the third member of the committee had not heard from either of the two other members of the committee. As it seemed to him it would, or should, be a cause of regret if no report whatever was made on so important a subject, he determined to prepare a paper on his own responsibility in the very limited time which the duties of his official position left at his disposal. This paper or report is therefore the work of a minority of one. After it was written it was submitted to another member of the committee, so that it has the sanction of the majority of the committee. Owing to the haste with which it has been prepared, it does not assume to be the result of an exhaustive or adequate study of the subject, but the facts it contains and the inferences therefrom are presented to the association, with the hope that they will excite a discussion which will suggest the direction that a more complete investigation of the subject should take in the preparation of a future report.

The last reports of the Railroad Commissioners of the States of Massachusetts, New York and Michigan show that during the year previous there were 217 railroad employés killed and 1,226 injured in these three States. From these same reports and from Poor's Manual we find that there were 4,856 locomotives in 1,426 railroads of these three States, and in the whole United States there were 25,937 locomotives. Now, it may fairly be assumed that locomotives in other parts of the country do about the same amount of work that they do in the States named. If, then, 217 employés are killed and 1,226 injured while 4,856 locomotives are doing a year's work, it may be inferred by a deduction of the single rule of three, that while 25,937 locomotives in all parts of the country are doing their work, 1,426 employés are killed and 6,548 are injured. This, then, indicates approximately the annual sacrifice of life and limb of railroad employés in this country. The calculation makes no pretense to giving accurate or precise figures, but it indicates with fearful emphasis what an awful amount of suffering, pain and anguish is due to this cause.

This is perhaps not an occasion for being pathetic, but it certainly is the duty of those who compose this association to do all in their power to lessen the risks to which those who operate railroads are exposed. With this end in view, let us inquire what are the chief causes of injury to trainmen.

From the reports which contain the figures quoted, the following classification of the causes to which the accidents are due can be made:

State.	Coupling or uncoupling cars.		Train accidents		Falling from train or engine.		Various causes		Total.		Number of locomotives.
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	
Massachusetts	2	105	8	18	17	38	36	50	63	211	1,445
New York	23	365	31	97	40	152	65	174	159	788	2,583
Michigan	11	104	3	21	16	37	16	65	45	227	828
	35	574	42	136	73	227	117	289	207	1,226	4,856

In the following table the percentage which the number killed and injured under each of the headings bears to the total has been calculated:

	Killed. Per cent.	Injured. Per cent.
Coupling or uncoupling cars	13.1	46.8
From accidents	15.7	11.1
Falling from trains or engines	27.4	18.5
Various causes	43.8	23.6
	100.	100.

This shows that nearly one-half of the injuries are from coupling cars, but that the percentage of fatal accidents from that cause is only 13.1, whereas 27.4 per cent., or more than twice as many, are killed from falling from trains and engines, but only 18.5 per cent. of the injuries are due to that cause. The large number of employés killed and injured by coupling cars, and by falling from trains will, or should naturally, lead the members of this association to inquire how this mortality and mutilation may be reduced, as the construction of cars has much to do with the risks to which the employés are exposed. Public clamour and indignation at the great sacrifice of life and limb from coupling cars has led to the inference that it would be very largely diminished if automatic couplers were generally adopted, and much of the time of this association has of late years been devoted to the consideration and investigation of the merits of various automatic couplers. Laws compelling the adoption of automatic couplers have been hastily enacted in various States, apparently without serious consideration or investigation of the question whether their use would materially lessen the number of coupling accidents. Owing to the large number and variety of self-couplers which have been put into use of late years, the members of this association should now be able to know whether they lessen or increase the danger to employés.

The important question whether the risk and danger in coupling cars would not be reduced more by improvement and uniformity of non-automatic draw-gear, than by the adoption of a variety of self-couplers or the attempt to drop one or very few kinds, is worthy of consideration and disussion by this association. Many experienced railroad men are of the opinion that automatic couplers will not reduce the danger and the number of accidents from coupling cars. There can be no doubt that the form and construction of non-automatic draw-gear can be improved and reduced to uniformity, and that if this was done and if the standards for their height and for the dimensions for dead-blocks recommended by this association were generally adopted, and if devices to side-guards, such as handles on the ends of cars, were generally provided, that coupling cars would be much less dangerous than it is now. The difficulties in the way of the adoption and the use of any one or even a few kinds of couplers are so great as to appear to be almost insurmountable at present. There are so many conflicting interests arrayed against each other, that at present it seems hopeless to reconcile them, and even if there were no such conflict, it does not seem that any self-couplers which could now be selected would be sure to lessen the risk of coupling cars, whereas it is certain that the improvement and reduction to uniformity of non-automatic draw-gear would make the occupation of the brakeman less dangerous than it now is.

Furthermore, it is very desirable that the draw-gear, and the ends of cars should be uniform in construction if an automatic coupler is adopted, so that if the efforts of this association should be directed to the improvement of the non-automatic draw-gear, it would first be certain to diminish the risk of coupling cars, and next such a change will make the adoption of automatic couplers easier in the future.

Regarding accidents caused by trainmen falling from trains, the following remarks of a highly esteemed member of this association, Mr. J. W. Marden may be quoted. In a letter dated June 11, he says:

"I would urge upon all the members the importance of having proper appliances on all of our cars for the protection of trainmen, and having them kept in good condition. We were receiving so many cars with running boards defective, ladder rounds, grab-irons, steps, etc., gone, that I sent out a circular letter to different roads asking them if they would approve bills for repaires to such appliances; not that it was according to the rules, but that it was what I considered a proper charge to be made.

"We have repaired running-boards, grab-irons, handles, etc., to as high as 300 foreign cars a month at North Adams, which shows that these appliances are not watched and repaired as they

should be. I am free to admit that our own cars are not up to the standard that they should be, and yet we are making every effort to bring them up, and would be glad to approve any bills for repairs of the safety appliances for trainmen."

Mr. Marden's remarks indicate that what is needed is more rigid inspection of cars. The author of this paper is not prepared to recommend any improvement in the appliances for the protection of trainmen from this class of accidents referred to, but he has no doubt that the experience of the members of this association would enable them to point out the defects and suggest improvements in the steps, handles, railings, etc., of the cars now in use. There seems to be no good reason why a standard should not be adopted for the construction, location and proportion of such parts of cars. If uniformity could be secured there certainly would be less danger to trainmen than there is now, when nearly every car in a train is different from every other car.

The aim of this paper is to present the subject in such a way as will call out disussion, and which, as mentioned before, will indicate the direction that the inquiries of the committee should take for a future report to guide the action of the association.

M. N. FORNEY,
JOHN KIRBY.

It was moved that the report be accepted and committee continued.

Mr. Forney explained that his object in preparing this paper was to elicit discussion and direct attention to the subject. He believed there was danger of disjointed action in favor of improved car couplers, making the dangers to trainmen greater in coupling cars than it now was. He was not sure that the general introduction of automatic couplers would accomplish the destined end. But it becomes us as men to do all in our power to diminish suffering.

Mr. Cloud wanted to direct the attention of the members to the figures. The proportion of men killed by falling from trains was greater than that of men killed in coupling cars. He believed that the men who fall off cars are thrown off by shocks of the trains due to slack couplers, and that any action of the association tending to reduce these shocks was calculated to prevent loss of life. He believed in making greater use of extended running boards, as it appeared to him that many men fell through owing to the distance between cars being too great. But the principle point he wanted to make was, that jerks caused the greater part of falling off accidents.

Mr. Adams recognized the force of Mr. Cloud's remarks, yet he found that the theory advanced did not agree with the facts of his experience. In fact, he did not remember a single case where it was found that shocks caused fatal accidents to trainmen. He found that the principle causes of accidents were defective ladders, defective steps, defective hand-holds, and defective running-boards. Among the most fertile causes of accidents to trainmen, he placed the extended running-board which Mr. Cloud had been recommending. The extensions of running-boards were often insecurely fastened and permitted springing of the end which jerked many men off. He wanted running-boards cut off flush with the roof.

Mr. Rhodes mentioned that at the brake tests at Burlington they had all sorts of accidents with cars that were all in good condition, and they appeared to support the positions taken by both Mr. Adams and Mr. Cloud. They had men thrown off cars and down from a cupola by jerks, and they had an accident through a defective ladder-round, which was of wood.

Mr. Jacob Johann (President of the Master Mechanics' Association) who had just arrived, was invited to take a place on the platform, was asked to give his views on the subject under discussion. He believed that the bad condition in which many cars were running was due to the master car-builders themselves. He believed in holding inspectors to closer account for the way they passed cars, and thought this matter of carding for defects needed to be closely watched. Many cars are running by the privilege of cards that ought not to be permitted to run in a train. In regard to couplers, he thought it high time that something definite was done. The idea of slack being a necessity was all wrong. The operating departments thought engines could get a car or two more over the road with slack couplers than they could when couplers were tight, but if this were so, loose couplers did more damage to cars and caused more delays through trains breaking in two than the increased movement of cars amounted to. He favored the hook type of close coupler.

Mr. Bissell thought that the way engineers handled trains had more to do with the damage done to cars than the presence of loose couplers.

Mr. Kirby said that two important points had not been touched upon. The first was the height of draw-bars. His experience had convinced him that a great many car coupler accidents were caused by the draw-heads being at different heights, and mentioned a case he had investigated where a man had been injured in coupling, and it was found that one coupler was 36 inches from top of rail, the other point he alluded to as a cause of accidents was the absence of guards to prevent a man from slipping off when he lost his footing on a slippery running-board. He advocated putting pieces round edge of roof to save a trainman under circumstances of this kind.

Mr. Adams found fault with the committee that submitted this report for not making recommendations.

The explanation was then made that the intention was to committee for further investigation and report, that recommendations would be made next year. Resolutions to that effect were passed.

REPORT ON STANDARD DRAW-GEAR FOR NON-AUTOMATIC COUPLERS.

To the Master Car-Builders' Association:

Your committee on standard draw-gear for non-automatic couplers beg leave to report that they sent out over one hundred circular cards to the leading members of the association, asking for opinions on the subject, together with what suggestions they might offer. To our solicitations we had the honor of receiving replies from six members—not a very encouraging state of affairs.

We herewith attach blue prints and tracing, showing the standard attachments on the Chicago, Burlington & Quincy, Central Vermont, Grand Trunk, Chicago & Grand Trunk, Lake Shore & Michigan Southern, and Chicago & Eastern Illinois.

They are what is termed the pocket draw-gear which, in our opinion, stands for safety and durability in wear and tear unrivaled to-day. But at the same time would call particular attention to the plans adopted by John Kirby, of the L. S. & M. S. Ry. The principal of which is that the thrust does not bear against the body bolster. The thrust being against continuous timbers, the butting pieces being 5×5¼ in., extending from the cross-tie timber to 11 in. forward of the body bolster, passing between the bolster irons and to guard against shrinkage of timber and consequent pushing up of bolster. He has inserted gas pipe thimbles, going through the butting pieces, the ⅝ in. bolts going through thimbles, which also hold center plates on. A casting is also used in addition to thimbles, thus preventing the breaking of center plates by bolster getting out of line, ⅞ in. bolts are used through end of butting pieces, floor timbers and another piece as shown, the whole of this is done to stiffen the bottom at bolster and prevent, if possible, the breaking off at the bolster.

The draft is not on the bolster but continuous. John Kirby also uses two springs abreast, both of which are used for pushing and pulling, in view of the heavy cars and still heavier loads this extra cushion seems indispensable, thus preventing the metals coming together, which is the great source of damage to draw-bar attachments. So long as there is an efficient cushion little damage can be done. We would especially recommend the consideration of this form of attachment to the consideration of the members of this association.

THOMAS SUTHERLAND.

Mr. Johann said that the defective way draw-gear is constructed is a constant source of trouble, expense and delay. He believed that from 50 to 70 per cent. of repairs to freight cars is in connection with draft attachments. The constant concussions that draw-gear is subjected to were hard to withstand. His remedy was to make the timbers, springs and connections strong enough to endure the shocks without breakage or distortion. He used a single strong spring, 10 inches, and found it stood better and gave greater elasticity than two weaker springs.

Mr. Kirby believed in properly cushioning draw-bars, but found two springs preferable to one. He thought the thick steel needed for a heavy spring would give out sooner than where lighter steel was used, and the requisite thickness could be got by employing two springs.

A motion to send the draw-gear arrangement used in the Lake Shore & Michigan Southern road to letter ballot for adoption as a standard, was agreed to.

REPORT ON STANDARD FREIGHT CAR TRUCK AND AXLE FOR CARS OF 60,000 LBS. CAPACITY.

The committee on a standard freight car truck and axle for cars of 60,000 pounds capacity beg leave to report as follows:

Your committee, with the limited time at its disposal, has felt that it was impracticable to prepare a general plan and details of a truck, and it has confined its work to submitting plans for such parts of a truck as are frequently renewed, and which, therefore, should be interchangeable and standard. There are accordingly submitted plans of: axle, journal box, journal bearing, journal bearing wedge.

In regard to the methods for securing uniformity in size of axles, which your committee was also to consider, the following is suggested:

That manufacturers be furnished with drawings, giving forge and finished dimensions, and that when axles vary from these dimensions they be rejected.

M. M. MARTIN,
R. C. BLACKALL,
W. A. SCOTT,
H. ROBERTS,
JOSEPH WOOD,
Committee.

The report was accepted and a resolution passed sending the paris to letter ballot as standards of the association.

REPORT ON BEST FORM AND CONSTRUCTION OF CAR ROOFS.

To the Master Car-Builders Association:

In offering their report on this subject for your consideration at this convention, your committee would take occasion to express their regret that they are not able to present any very decisive conclusion in the matter they were appointed to report upon. They feel assured, however, that no weakness of purpose or remissness of action will be attributed to them if members will recall for a moment the nature of the subject under inquiry. In a large majority of cases we, as a body, are called on to deal with, and discuss points strictly within the limits of ascertained mechanical law; thus having some positive data to go upon, and, if necessary, a "court of final appeal." But is it so in this case? They think not. The conclusion to be arrived at being necessarily dependent upon the wear and tear of years, they have had to abandon for the time their dry rules of logic and mathematic formula, to collect and condense the fruits of past experience.

Your committee are glad to be able to report that they have received valuable assistance in their inquiries from most quarters, and in particular they would like to make special mention of the hearty co-operation extended to them by Mr. G. W. Rhodes, who very kindly furnished full copies of a report on this subject by a committee of master mechanics connected with the Chicago, Burlington & Quincy system. The replies received give information of eleven forms of roofs, as follows: In metal, The Winslow, Chicago, National, Empire, Anchor, Grand Trunk, sheet iron and tin. In composite, The Winslow, Asphalt and the Hutchins composition, and, bringing up the rear, the old time double board and single board and battens, the latter specially for stock cars.

The first three, Winslow, Chicago and National, may be classed as under roof, *i. e.*, the metal sheets are exposed to the inside of car, and the top is covered with a single course of boards.

The others may be classed top roofs. A course of boards is laid on the carlines or purlins, and the metal sheets laid on top. A good type of the top sheet principle is the roof in use on the Grand Trunk system. It can be laid on top of first course of an old double board roof; or, when put on new, purlins need not be used, as the roof boards may be laid on the carlins, which stiffens the car very materially, and is less expensive. The iron is in sheets reaching across the car, and nailed to the facia. The joints are covered with rolled iron U ribs, gathering the edges of the sheet within the U, making a perfectly water-tight surface.

There is only one form of tin roof reported, and it is applied in the usual way. The use of plate tin for roofs is gradually becoming obsolete.

In order to bring the question most effectually before this convention for discussion, your committee have thought best to mention some of the objections that have been made to the different forms of roofs.

From localities where baled hay and cotton, machinery, furniture, and similar bulky freight is handled, the metal roofs that are not protected on the under side very often become broken or punctured. Some of the lines running from very cold into very warm latitudes complain that the iron under-roof sheets become coated with frost, and when cars pass into warm climate the frost melts and causes damage to freight. For the reasons above given, a metal roof with under protection, or the double board, would seem to be preferable. Then, again, objection is taken to the top metal roofs that they rust and corrode too fast, owing to exposure to the weather; also that they are liable to wear and breakage by being run over and punctured by the too generous use of the "bull punchers" of stockmen. The Winslow asphalt and Hutchins composition can scarcely yet be considered of age, but they have many good points; as any rate, they are succeeding in making themselves known. But when the top course of boards begins to warp up up under a hot Southern sun, or, in turn, is subjected to a Western water spout, the effects on the, by this time (say ten years), hardened asphalt and other "compounds" may not be at all desirable. The double-board roof, which so many of us have stood by for so long, and which yet has so many friends, is at last beginning to lose ground, as a master car-builder in the Southwest very pointedly says, "cut nails" wouldn't hold it, then "wrought nails" were tried, with the same result, and now we are trying to keep them down with screws and "barbed wire nails," "but all in vain." Another says: "The paint we have put on in ten years, to keep it from leaking, is as thick as the original roof itself." This, of course, is a mild exaggeration, but still, it conveys a moral.

Your committee think that in the foregoing will be found ample material for discussion, but they also believe they would only partly be fulfilling their duty did they not lay before the convention a brief statement of what appears to them the requisites for a good car roof. It is, then, their opinion that what is needed is a durable and substantial roof, that will last the life-time of the car without continual repairs, and be free from leakage when the car is sent to the "bone yard;" a roof that will increase the life of a car, because it will by a protection to the growing decay; a roof that will fully meet the requirements of both extremes of climate, a Southern sun or a Canadian frost. To attain these ends, and at the same time meet the variations and exigencies of traffic, the coming roof must be protected on the under side as well as on the top, while such protection should do service as part of the car frame to stiffen and strengthen it.

While confessing their inability to offer anything better than what is at present in use, your committee have made free to pick holes in the more prominent types of car roofs now in favor, for only in that manner can we discover how to stop them up again. Yet if any one should think this is rather a lame and halting conclusion to arrive at, they would recall to his mind their opening remarks, that the determination of the best car roof must necessarily be a slow process, since in that determining that determining they have to compete with the influences of nature. This fact, taken in connection with the wide divergency of opinion and practice at present observable in the matter, together with the comparatively small amount of experience obtained so far of any other kind of roof than the old "board roof," makes it evident that for your committee to recommend any one roof to the association at this present time

SYNOPSIS OF REPORTS ON CAR ROOFS.

NAME OF ROAD.	Roofs used.	Remarks.
Missouri Pacific.	Galvanized iron on top of roof boards	Top iron roof gives increased strength to car body. Iron especially good in South and West, where lumber swells and shrinks and turns up at edges and becomes loose on account of continued rain or sunshine.
	During past 5 years "Anchor" iron roof.	
	Also ventilated galvanized iron for fruits, etc.	Can be repaired easily. Throws water and cinders off easily; good roof; better than under iron roof.
	Winslow under roof.	Not in favor. Boards twist and get loose very quickly.
Michigan Central, Can. South. Div.	Winslow iron roof.	6 out for 15 years. Cost $38 for 30-foot car.
Michigan Central.	Hutchins' composition.	Double board with Hutchins' composition between. Good satisfaction; 2,000 cars have it; 550 more this summer. Cost for 34-foot car $55.
Lake Shore.	Winslow roof of galvanized iron, No. 23 wire gauge.	Good for 10 years. Cost $43.50.
	Winslow asphalt.	Superior to Winslow iron roof, as it adds to stiffness of car and prevents perforating from inside. Intermediate purlins not necessary. Cost $40.
Grand Trunk.	Sheet iron, with roof ribs and saddles	Good satisfaction. Cost $18.45.
Baltimore & Ohio.	L. C. Lorne, charcoal tin.	Cost $13 per car. Average life 15 years.
Northern Pacific.	8,000 cars ordinary double board roof.	Objection to iron roof, because so much cold weather, and iron gets coated with frost on inside, but when car gets into warmer country frost melts and damages freight.
	Winslow asphalt.	Gives satisfaction.
Burlington & Northwestern.	Double board.	All cars.
Chicago, Burlington & Quincy.	"Eagle" roof.	No particulars.
Report of Master Mechanics.	"Empire" roof of Chicago; corrugated galvanized iron.	In use 11 years. One of the cheapest and best; cost $38 for 34 foot car; if roofing boards used cost less than $30 per M., roof will be correspondingly cheap.
	Winslow asphalt.	Good and cheap as the rest; in use 6 years; believed to last as long as body of car; cost from $32 to $34 for 34-foot car.
	Hutchins' composition.	Good and cheap as the rest; believed to last as long as body of car; cost from $32 to $34 for 34-foot car.
	Double board roof not favored. Should be superseded.	Winslow asphalt roof has an advantage over all others, in that the under course of boards running lengthwise of the car stiffens the roof. Asphalt roof favored as against corrugated iron, because cheaper; iron liable to rust and have holes punched through it. Cost for 34-foot car $27. Recently applied; not prepared to give it preference; thinks iron under roof best, similar to Winslow metallic roof.
New York, Lake Erie & Western.	Winslow asphalt.	Box cars.
		Stock cars.
Atchison, Topeka & Santa Fe.	Winslow roof, galvanized iron.	Box cars.
	Double board.	Stock cars.
St. Joseph & Grand Island.	Winslow roof, galvanized iron.	Not satisfied with it; in favor of some sort of metallic roof.
	Double board.	Box cars.
Chicago, St. Paul, Minn. & Omaha.	Double board.	Stock cars.
Chicago & Alton.	Winslow iron.	Last a number of years; never knew one to be worn out; double board not suitable to the climate.
	Double board.	Stock cars.
Union Pacific.	Winslow iron.	Tried it for 3 years; found perfect on examination.
		Stock cars.
Minneapolis & St. Louis.	Double board roof.	On 100 cars; think double board roof preferred for all purposes; cheapest in maintenance.
	Hutchins' composition.	Standard for all cars.
Central Iowa.	Double board roof.	Not sufficient experience of either to speak positively.
	Corrugated galvanized iron.	
Chicago, Rock Island & Pacific.	Double board.	Give satisfaction.
	Chicago car roof, corrugated iron.	
	Winslow asphalt.	All cars. Made no experiments so far with others, as lumber is cheap in this district; think of making experiments.
Chicago & Illinois.	Double board.	
	Winslow asphalt.	
Chicago & Northwestern.	Double board.	

would be to lay themselves open to the objectionable charge of undue favoritism.

They, therefore, beg to recommend that the subject be carried over another year, and in view of the fact that the Chicago, Burlington & Quincy system are making valuable inquiries and experiments on the car roof question, that they be represented on the new committee.

Through the kindness of parties interested, there will be found for your examination blue prints and models of quite a number of the roofs referred to in this report.

Attached is a tabulation of the reports received, giving name of road, roof used and remarks thereon.

J. D. McILWAIN,
L. PACKARD, } *Committee.*
S. IRWIN,

The report was accepted and the committee continued.

This ended the business connected with reports, and the subject of Car Heating was again brought up for discussion, but no expression of views was elicited.

Mr. Wall moved that Car Heating form the subject of investigation by a committee to report next year. Carried.

The committee appointed to select a place for the next annual meeting reported in favor of Alexandria Bay, Jefferson County, N. Y., and the convention agreed to meet there next year.

ELECTION OF OFFICERS.

The following officers of the Association were elected for the ensuing year:

President, Wm. McWood, Montreal, Canada; *Vice-Presidents*, John W. Cloud, New York, Lake Erie & Western, Buffalo, N. Y.; E. W. Grieves, Baltimore & Ohio, Baltimore, Md., and John S. Lentz, Lehigh Valley, Packerton, Pa.; *Treasurer*, John Kirby, Lake Shore & Michigan Southern, Cleveland, O. *Executive Members*, R. C. Blackall, Delaware & Hudson Canal Co., Albany, N. Y.; R. D. Wade, Richmond & Danville, Richmond, Va., and Thos. A. Bissell, Wagner Sleeping Car Co., Buffalo, N. Y.; *Secretary*, M. N. Forney, 45 Broadway, New York.

American Railway Master Mechanics' Association.

TWENTIETH ANNUAL CONVENTION.

The convention met on Tuesday, June 21, in the Chamber of Commerce Hall, St. Paul, Minn., and was called to order by Mr. Jacob Johann, president of the Association.

The proceedings were opened with prayer by Rev. Robert Forbes.

Mr. C. D. Kerr, President of the Common Council of St. Paul, welcomed the Association to the city, and an address of welcome was also delivered by Mr. Thos. Cochrane, vice-president of the St. Paul Chamber of Commerce.

Secretary Setchel then called the roll, and 90 members, including 3 associate and 1 honorary member, answered to their names, being the largest attendance ever present at the opening of an annual meeting of the Association.

PRESIDENT JOHANN'S ADDRESS.

LADIES AND GENTLEMEN: While it is with pleasure that I greet you at this, the opening of the twentieth annual meeting of the American Railway Master Mechanics' Association, it at the same time becomes my painful and distressing duty to announce to you that during the past year death has again invaded our ranks and removed from among us our President, Mr. William Woodcock, which sad event places me before you to-day as your presiding officer.

By the demise of Mr. Woodcock the association loses one of its most prominent and tireless workers; one who was ever at the front doing all that lay in his power that would tend to promote the greater success of the Association.

We shall not only feel the loss of his hearty co-operation as a fellow member in our deliberations, but also in our social relations where we shall miss his genial presence as a friend.

Before our final adjournment it will be a fitting action for the members of this convention to express in some suitable way their sorrow and feelings at the great loss sustained by the Association.

In addition to the death of our president, it becomes my sorrowful duty to chronicle the decease of the following other members during the past year, namely, Mr. Geo. Colby, Mr. W. W. Evans, Mr. H. G. Brooks and Mr. Geo. E. Howe.

These gentlemen were among our oldest and most prominent members. We shall miss them in our labors and discussions by their silence, and socially, where once cheered by their presence, we shall now be grieved by their absence.

Upon receipt of the notice from our secretary announcing the death of President Woodcock, I immediately authorized Mr. Setchel to go ahead and attend to all matters pertaining to the Association, which, from his central location, he could handle with expedition, and this he has done in his usual prompt and correct manner, for which he has my thanks and deserves your approbation.

It is a source of great pleasure to us to note the attendance of so large a number of ladies at these our annual meetings, and I am certain that their presence and smiles have a cheering influence for good, and serve as an incentive for us to do our best. In thanking them for their kindly presence I know that I only express the unanimous voice of this assembly.

Although we have met in nineteen annual meetings, and have discussed many problems of our profession, thre are many other and quite as interesting subjects still remaining for our consideration and deliberation, that closely regards the better and more economical management of the rolling stock placed in our charge. Your special committees will lay before you the results of their investigations and their recommendations in regard to the various subjects committed to their care, and your careful consideration and assistance in the discussion of these subjects is respectfully invited during the session.

For the growth and financial standing of the Association, I respectfully invite your attention to the full and comprehensive reports of the Secretary and Treasurer, which will be presented to you during the session.

Thanking you for your kind attention, and asking your indulgence as presiding officer, I now declare the Association open for such business as may properly come before it.

THE LATE PRESIDENT WOODCOCK.

Mr. J. D. Barnett (Grand Trunk Railway) said that it was his pleasant duty at Boston, one year ago, to announce that Wm. Woodcock had been elected president of this Association. The speaker now sadly misses the pleasant face and hearty hand-shake of his friend of long standing, and he moved to have the president appoint a committe of three to draw up suitable resolutions respecting the decease of their much honored president.

The president appointed on this committe Messrs. J. D. Barnett, J. N. Lauder and H. D. Garrett.

A motion was carried calling for an interval of half an hour to enable the committee to frame suitable resolutions.

When the meeting was again called to order, Mr. J. D. Barnett read the following:

This convention, renewing and acknowledging that our Universal Father doeth all things well, in sorrow at the loving decree that removed from among us so suddenly William Woodcock, whom we had, after due deliberation and with full knowledge of the man, so unanimously chosen to preside over our meetings at this time and place, we had so chosen to honor him—yes, and to honor ourselves—because of our belief and trust in his sterling worth, in his clear integrity of purpose, in his high moral and intellectual worth, in his noble yet becomingly modest life, and because of his enthusiastic interest in his profession, and in our association, whose object is to raise that profession by increasing the knowledge of nature and nature's laws. We loved him as a brother man, we reverence his memory now that he has passed over to the majority, and if the loss is so widely, so keenly felt by us, how much more so by those close and closer to his warm heart with whom we fully sympathize. By the committee.

J. DAVIS BARNETT,
J. N. LAUDER,
H. G. GARRETT.

Mr. H. N. Sprague (Porter Locomotive Works) moved that the report be adopted and entered in the proceedings of the association.

Mr. J. N. Lauder (Old Colony) paid an earnest and eloquent tribute to the memory of Mr. Woodcock. Had found him one of the hardest working members of the association, ever ready to take part in any labor tending to promote the interests of the business they were all interested in, admired the man for his sterling social and professional qualities.

Mr. Angus Sinclair (NATIONAL CAR AND LOCOMOTIVE BUILDER) had for some years enjoyed the privilege of frequently meeting Mr. Woodcock socially, and testified to his many genial and endearing qualities. Professionally he was a thoroughly progressive man, ever ready to work out or to adopt improvements calculated to make railroad machinery better adapted for the work it had to perform.

Mr. R. H. Briggs (Atchison, Topeka & Santa Fe) had enjoyed pleasant intercourse with Mr. Woodcock for years, and found him a model man and a Christian gentleman. In looking over the annual reports, he finds Mr. Woodcock's name very prominent among those engaged in carrying on investigations on behalf of the association. He had done earth's work well, and was fully prepared when he received his call from the Master Mechanic of the Universe.

President Johann testified as to the opportunities he had enjoyed for estimating the character of our late president, and considered him one of the men whose lives make the world better.

TOPICAL SUBJECTS.

The hour having arrived that is usually devoted to the discussion of topical subjects, Mr. Barnett said that he would like to have the experience of members with screened coal compared with run of mine coal.

Mr. H. A. Whitney (Intercolonial) had used run of mine coal to some extent. When the coal was very soft there was so much slack that they did not get it to do well, but when the coal was a hard quality of bituminous there was no difficulty in using run of mine coal. As it was cheaper than screened coal some saving was effected.

Mr. Sprague thought that the success that would attend the burning of run of mine coal would be influenced by the kind of grates used.

Mr W. A. Foster (Fall Brook Coal Co.) said they were burning bituminous slack coal very successfully.

EXTENSION SMOKE BOXES.

Secretary Setchel raised the question: Is the extension front, as applied to the locomotive, economical? He did not think railroad companies in the Northwest were using the extension front so much as it is used in Eastern States. While there is a difference of opinion among us regarding this device, it becomes us to find out whether this arises from local prejudice or from a better cause, and whether the extension front is good for nothing after all. It seems to me, if it is good for any thing it is good for preventing the throwing of sparks, and will, when rightly applied, prevent in a great measure the starting of fires along the track. I will not say that it is a great saving of coal, but it must effect some saving in this respect. The continuous draft enables you to run with a light fire, which is the secret of the saving. Old roads that have used the extension front for years would not do without it on any account.

Mr. Lauder: For the past three years I have been using the extension smoke arch exclusively; that is, putting them on to our old locomotives as fast as we can get them into the shops. We have substantially all of our engines equipped thus. Of course we use the high exhaust and also the single exhaust which works very much better where the extension is used. There is a very soft pull on the fire by our engines. What sparks do pull through the flues are almost entirely deposited in the front end of the engine. To give the gentlemen present an idea of how critical the passengers are about Boston in this matter of sparks (on our road any way), they are so critical that having once ridden behind an engine with a straight stack, if we put an engine on with an old diamond stack there would be a row; that is a fact. And while you are not perhaps troubled with such a critical class of passengers in the West as in the East you have got to come to it; something that will prevent the emission of sparks that are thrown out by the ordinary stack construction. In the matter of smoke we are not troubled to the extent you are in the West. But, of course, unless we have the proper appliances we have some smoke from bituminous coal. Without a large boiler and careful firing it will be impossible to prevent the emission of smoke, but with a large boiler with straight stack, extension front and arch and evils of smoke will almost entirely disappear. Now with reference to the proper arrangements of the pipes while the extension is used. I soon found there was a difficulty in getting sufficient draught, the pipes with the exhaust and the baffle plate so completely filled the arch up that it was difficult to get proper draught. In the engines recently constructed instead of bringing the exhaust pipes out of the bottom in the usual way I bring them out where the steam pipes usually go in and then bring the steam pipe out behind next to the flue sheet. This makes the cylinders rights and lefts; but this can not be done away with. My object was to leave a clear draught and it does it admirably. I know the draught of the engines have been improved very much, and it prevents entirely the tendency to back up the sparks back of the exhaust pipes. I have less troubles with the flues at the back of the boiler stopping up. This I mention not to blow my own horn, but it is a step in advance. In setting fires I think that the extension front when properly arranged, the baffle plate put up as it should be, will almost entirely prevent the setting of fires by sparks from the smokestack. We have perhaps on one division of our road, on Cape Cod, as bad a place at certain times of the year as can be imagined. We have what we call the pine needles; they are very inflammable, as much so as gunpowder. We expect to pay some damages in the future, but do know that the danger from setting fires has been largely decreased by the use of the extension smoke arch. In no case have we failed to make steam better; I do not think there is any saving of fuel however.

Secretary Setchel: I have just been reminded that the Northern Pacific and Manitoba roads both use the extension. The Rock Island lines do not use it at all, and a number of other roads do not believe in it. It is for their benefit as well as our own that we should discuss this matter. If we can only bring out an expression from such a body of mechanics as this it will arrest the tendency to taking these out.

Mr. John Hickey (Milwaukee, Lake Shore and Western): I believe that the success of the extended front on the locomotive depends on the manner in which it is constructed. If improperly constructed it is certain to fail; if properly so, certain to be a success. We have to-day over 40 locomotives equipped with it, and although we experimented over a year, I have to say it is not only a saving in fuel but a great saving in not having sparks starting fires. It saves the material in nose and netting. I believe it is the proper way to construct the front of a locomotive. It should have by all means a tight front end and a properly constructed smoke stack, also have the deflector plate at its proper point, all of which will be found by experience and by looking up some records we have made, and some drawings we have on hand. I believe the day is coming when every locomotive will use the front end.

Mr. Wm. Swanton (Pittsburgh, Cincinnati and St. Louis): About three years ago I commenced putting these on and have continued so to do. At present we have about 80 running with extension fronts. A few engines were placed on our road lately that did not have them, but had the open stack and netting in ordinary sized smoke-box, and the fires they were said to have caused were equal to the value of the engines. I was ordered to take those engines off until I could put the extension front on. We do not claim there is any great economy in fuel, but so far as comfort, cleanliness and fires are concerned there is economy.

Mr. McKenzie: I am one of those who do not believe in an extension front end. Experience has taught they are not what they say they are. Five thousand pounds additional weight on the front truck is so much dead weight. Economy in the use of fuel is largely in favor of the common front end. With a properly constructed front end, with the brick arch we get less smoke and better result with a run of coal and do not set any fires. To illustrate that, I will say an engine to run 140 miles will fill that front end twice or nearly so on a heavy train and when once full it is far more dangerous than an ordinary stack. I can cite cases along the line of our road. The H. & O. use the front end and in case of dispute with another road about a fire, the B. & O. claimed the engine that had the diamond stack on set the fire, but when the evidence came in it was shown that the one with the front end on had caused the fire, because she had run 150 miles and had not been cleaned out. With a properly constructed diamond stack, with a good large exhaust nozzle and a brick arch, I believe there is more economy than in the extension front.

Mr. Burford: My experience is that the diamond stack is more expensive than the other. I am in favor of the extension front as we have had less fire.

Mr. H. L. Cooper, (Lake Erie & Western): In 1858 the B. & St. J. were using the extension front, and the Wabash, and I think they will get sick of it now. As if it was necessary to catch a car-load of sparks! With these extension fronts we ride behind, you can hold your hand out the window and catch sparks any time. For the engines we are running I have 52 or 53 equipped with the straight stack, with a long nozzle, and we do not have any trouble with fire, and a good many of the engines we use 4 × 4 No. 11 wire netting. I have had them running two and a half years and the netting and smoke stacks have not cost me a dollar, there is not only the reduction in the first cost but in the tin roofs and paint on our cars: the cost of these has been reduced by this device. It is the same thing as the extension front, only does not have the extension. It is nothing new. I do not believe in paying 100 dollars for an extension front and putting it on where you do not want it.

Mr. Towne, in a long speech, accused the association of making no progress. He was particularly hard on those who had adopted the extension front, and intimated that it was a backward movement, as the device had been twice tried and abandoned in years gone by. Considered the work of cleaning cinders out of extension fronts to be wasted labor. Said the right way was to cause the exhaust to throw the sparks into the prairie. Although not now in railroad service, he had read the reports carefully, and considered the association was not making satisfactory progress.

Mr. Lauder: After the scolding we have heard, I would suggest that a motion to dissolve this association would be in order.

Mr. Sinclair: I have been in the habit of paying very close attention to the proceedings of this association. I do not believe there is a man belonging to it who has read the whole reports with greater care than I have done. I am very strongly under the impression that the reports have always improved over those that went before them and showed the very strongest signs of progress. The association has the very best testimony in its annual reports of what it has been doing and the progress made. That the extension front has been tried again, is, I think, a sign of progress instead of the opposite. The extension front has come in because it has been found it would keep the sparks in a place where they could do no harm. If the master mechnics of the country are able to carry their sparks to the end of the road and not raise fires they are certainly going on the line of progress. The extension front is being brought into use because all kinds of stacks have been tried and have been found wanting. If you can put an open stack and plain front end on without any netting or cone or other spark arrester you are going to have better work from your engines, but that is impracticable. The best

thing to do is to use the device that will obstruct the draught as little as possible and not throw the sparks. Every one who has tried the extension front and put it on properly admits it prevents sparks when not full.

Mr. Towne: I did not intend to cast any reflection on the progress made by this association. You have made progress and very great progress. My idea was to impress upon the minds of the members of the convention this particular subject. This is a subject in which all the railroads are interested and will command perhaps greater credit if properly handled than any other subject I know of.

Mr. Roberts: I am very much in favor of the extension front. Have had considerable experience with that and must say that I am more in love with it now than I could expect to be. We use the 3½ mesh netting, 13 wire gauge and though not able to overcome the fine ashes that get into the passenger's eyes and ears, we do stop throwing out any sparks sufficient to damage any shops we pass or roofs of cars, or burn property. In regard to weight I think you will find the necessary extension will not exceed from 1,000 to 1,500 pounds. The objection raised to them by a great many roads is that sparks will get on fire, warp the sheet and the engine be delayed for repairs and the master mechanics will feel sore. I investigated this matter and asked some roads' opinion. There were some engineers who spoke very kindly of them, but it was through faulty workmanship. Our officers ordered to have this device and we have not abandoned it yet. We all know of the feeling against the use of new devices, engineers are against them. I remember when the injectors first came in, the engineers would not use them. See how many roads in this country are using them now!

Mr. Joseph Whitlock tried the extension front against his will, but its performance convinced him that it was the best spark arrester he had ever seen tried. Had extension fronts running five years without change of netting.

Mr. E. L. Weisgerber (Baltimore & Ohio) had used the extension front for many years, and the merits of the device as a spark arrester and means of saving coal made it so popular that the company ordered it on all classes of locomotives.

Mr. Sprague thought that the defective work was the cause of the extension front proving a failure on some roads.

Mr. Briggs thought the extension front the best spark arrester he had seen tried. Had experience with an engine that pulled a train 150 miles without emptying front, and then had but few sparks in the box. The reason of this was, that the nozzle was so large that the sparks were left in the fire-box where they belong. Wanted to have standard form of extension front adopted.

Mr. Hickey had netting in extension fronts that had been in use four years. If the cinders in the front end took fire it was a certain sign of air leaking in, and an air-tight smoke-box was essential to the successful use of the extension front.

Mr. Setchel was ready to take any diamond stack engine, and by changing to the extension front show a cleaner train, less consumption of fuel, and less fire-raising on the right of way. Putting on an extension front and open stack enables steam to be kept up after increasing the size of nozzles ¼ to ⅝ inch. Wanted to know if this meant nothing in the line of saving? Mentioned case of a road that he was appointed to, which had failed to make the extension front a success, and it was known as the dirtiest road in the country for passenger travel. He made it one of the cleanest roads to travel on by making the extension front a success. The extension front is being brought into the courts, owing to its success as the best known means of preventing the throwing of sparks. Believed that on the roads where the extension front was a failure that firing was done in the heavy careless way that prevailed where the diamond stack is used.

Mr. Meehan: When I joined the Cincinnati Southern in 1881 there were using the old diamond stack or the stack in use now where the diamond stack is used. In 1881 that company paid $33,000 for damages through fire. The president of the road appealed to me, asking if I could do anything to prevent the great loss the company were monthly incurring by setting fire to property. I inquired round and Mr. Sechtel told me about an extension smoke box that he was using. I applied it to some engines but they would not steam. They had been used on passenger service and caused delay, so I took them and put the engines on freight trains till I could experiment to find out the cause of the trouble. I soon found out how to make the engines steam first-class but the extension soon filled up with sparks. To prevent this I introduced fire-brick arches in the fire-boxes. The brick arch and the extension front work in harmony. At that time we had 32 engines 17 × 24 inches, and 16 engines with cylinders 18 × 24 inches, and the coal consumption was 91 pounds to the train mile. The fuel consumption per mile is now 62 pounds per train mile, notwithstanding that a large percentage of our engines are much heavier than they formerly were, many of them being consolidation engines Every engine is equipped with the extension smoke-box and brick arch in fire-box. Have not paid a dollar for fire since the road has been thus equipped. On one occasion the general manager told me that a certain road had introduced a new system similar to mine, only without an extension, and the engines were giving just as good satisfaction as the engines equipped with extensions. I sent a man to investigate and report. On returning he said the engines would do well on a light pull, but when they came to a heavy grade they would throw sparks enough to light up the whole country. The cost of the extension is nominal outside of the brick arches. The brick arches we use are 5 at a cost of sixty cents; we use two set a year. If the extension is put on properly, *tight*, you will never have any trouble with it. In the second place, if you introduce the brick arches, it will prevent the sparks being carried into your extension. It will be found to be a most wonderful economizer of fuel. On the third year we had everything equipped.

The discussion was then closed and the meeting adjourned for the day.

SECOND DAY'S PROCEEDINGS.

The first business called upon was the reading of the

SECRETARY'S REPORT.

Secretary Setchel opened his annual report as follows *Gentlemen:* You are again presented with our printe annual report. It contains 207 pages; it has been compiled by the same secretary and printed at the same works as last year, and we will guarantee that it contains as many mistakes that will require your criticism and forbearance. It is said that when Webster first issued his unabridged dictionary he sent a copy to Cushing, and asked his opinion of the work. That gentleman acknowledged the receipt of the book and said it was very creditable and contained as few errors as might be expected in a work of that kind. Webster, highly indignant, sent back a note asking him what he meant. Thereupon that gentleman, it is said, wrote down and pointed out to his friend five thousand mistakes. So we think this report is as free from mistakes as is usual in a report of this kind. In any event the report has gone forth, and the members and others have the opportunity to judge, for the secretary has endeavored to see that each member should have a copy, and seven hundred have been sent to railroad officers. We therefore submit it to your approval as a body.

The Secretary then proceeded to give details regarding membership, which showed that the association had 251 full members, 41 associate and 14 honorary members. Total, 270.

The Secretary and Treasurer's reports showed that the association was in a sound condition financially.

Next subject in order was the reading of reports of committees, and the Secretary read the

REPORT OF COMMITTEE ON PROPORTIONS OF LOCOMOTIVE CYLINDERS.

To the American Railway Master Mechanics' Association:

Your Committee on Proportions of Locomotive Cylinders beg to make the following report:

Circulars embodying questions bearing on the subject were printed and distributed by your secretary, and, in addition, a few copies were forwarded to locomotive superintendents of Great Britain.

Judging by the very small number of answers received, it would appear that the matter is generally considered a subject well understood, and not open to further discussion. Much difference of opinion must exist, however, or we should not find in examples of modern locomotive construction such variations in the ratio between tractive power per pound of mean effective cylinder pressure and weight available for adhesion.

Communications in reply to the circular have been received from the following gentlemen: Mr. J. D. Barnett, of the Grand Trunk Ry.; Mr. J. McGrayel, of the Des Moines & Fort Dodge R. R.; Mr. James Meehan, of the Cincinnati, New Orleans & Texas Pacific Ry.; Mr. Angus Sinclair, of the NATIONAL CAR AND LOCOMOTIVE BUILDER; Mr. Thomas B. Twombly, of the Chicago, Rock Island & Pacific R. R.; Mr. S. G. G. Copestake, of the Glascow Locomotive Works, Scotland, and from Mr. F. W. Webb, of the London & Northwestern Railway, England.

Mr. Barnett gives the following rule for finding the diameter of cylinder when stroke of piston, mean diameter of driving wheels and weight on same, also boiler steam pressure, are known, viz.: *the square root of the adhesive power, multiplied by the mean diameter of drivers, divided by the mean effective cylinder pressure, multiplied by the length of stroke*—all weights being expressed in pounds, and measurements in inches.

This rule requires the assumption of a co-efficient for adhesion, also of the mean effective cylinder pressure. Mr. Barnett, in the example quoted by him, uses one-fifth as the co-efficient, and states that as the work to be provided for is the maximum, the mean cylinder pressure should be fully nine-tenths of the initial pressure, which should be not less than seven per cent. below the full boiler pressure.

Mr. McGrayel states that he adopts practically the same rule, but his experience teaches him that when using a fraction over fifty per cent. of boiler pressure, as the mean cylinder pressure, it is necessary, in order to obtain good results, to use one-sixth as the co-efficient for adhesion in the case of passenger engines, and one-seventh for freight and switch engines.

Mr. James Meehan reports using the same rule, but assumes ninety pounds as the mean cylinder pressure, in conjunction with $\frac{5}{7}$ as co-efficient for adhesion.

Mr. Angus Sinclair gives no rule, but states that the proportions of cylinder and the elements of adhesion are subject to a proper ratio, and that any material deviation from the same, should be considered a mechanical blunder.

Mr. Thos. B. Twombly reports making use of the rule found in Forney's Catechism of the Locomotive, and as follows: *Multiply the total weight on the driving wheels, in tons of 2,000 pounds, by five, and then by the circumference of drivers, in inches, and divide by four, the quotient being the cubical contents of each cylinder.*

This rule was proposed by Mr. Forney, in consequence of the results obtained with engines at the time his excellent book was written, but on account of the considerable increase in boiler pressure generally adopted since that time, it is obvious that the rule now requires modification to suit the altered conditions.

Mr. Copestake reports using the same rule, and like Mr. Barnett, assumes one-fifth as the co-efficient for adhesion, but uses 63 per cent. of boiler pressure as the mean cylinder pressure. Like Mr. Twombly, he makes no allowance for wear of tires, the diameter of wheels over the tires when new being used in the calculation.

Mr. F. W. Webb states that he has no hard and fast rule, but in ordinary practice adopts a 24-inch stroke of piston, and arranges the diameter of cylinder so that the tractive power at starting, with full boiler pressure, does not exceed the adhesive power under the most favorable circumstances.

Mr. Barnett considers that no deviation should be made from the rule, whether the engine in question be for passenger, freight or switching service. He, however, before stated, recommends the co-efficient for adhesion to the one-sixth for passenger and one-seventh for freight and switching engines. Mr. Copestake expresses the opinion that the rule as given by him should apply to both passenger and freight engines, but in the case of switching engines, the stroke may be longer in proportion to the diameter of the cylinder. Mr. Webb states that he adopts the same rule for both passenger and freight engines.

In reply to question No. 5 of circular, Mr. Barnett states: "When tractive force is in excess of adhesive weight, the results, although not necessarily bad, usually are so, if the engine is in the hands of but an ordinary engineer, as the engine, slipping her wheels so easily, is often allowed to do so, causing not only excessive wear of tires and machinery, but also wasting the steam and throwing away the fuel. Nevertheless, within the narrow limits permissible in locomotive design, the larger the cylinder, the more economically the engine can be worked in the matter of fuel consumption. This was the opinion and practice of M. Marie, of the Paris & Lyons Railway, and the experiments then carried out (and recorded in the Proceedings of the Institute of Mechanical Engineers, May, 1884) with an eight wheels coupled passenger engine on mountain service, having cylinders 19¾ × 23 in.; wheels, 49⅜ in. diameter, with about 58,000 lbs. on drivers, show a consumption of 2.88 lbs. of fuel per indicated horse-power, or 3.27 lbs. per actual horse-power, and but 30 lbs. of wet steam per horse-power developed. This was achieved with steam at 128 lbs. pressure, cutting off at 19 per cent. of stroke; weight of train, 163½ tons; speed, 17½ miles per hour on a continuous grade of 1 in 53¾. However, whether all that is involved in such expensive construction is justified in a district where fuel is cheap, is open to serious question." He further states, when referring to another portion of the subject: In other words, it is not advisable to give an engine having a boiler pressure of 150 lbs., driving wheels of 66 in. mean diameter, and a weight on them of 66,200 lbs., cylinders of larger cubical capacity than 17 × 24 in., without the conditions of daily service under which the engine is expected to work are so exceptional that it is a matter of great importance that very little water should be used by the engine, or that she must be very economical in fuel, under which circumstances it would be advisable to make a decided outlay in cylinder cloth-ing, even to the extent of steam-jacketing.

Mr. McGrayel states that when the weight on drivers is less than in the proportion recommended by him, he finds that engines do not give satisfactory results, on account of slipping, which necessitates use of sand, and consequent wear of tires; and when wheels are slipping, and are caught on sand, crank pins and side rods are very liable to be bent or broken.

Mr. Meehan states that the weight on the driving wheels is a point of great influence on the efficiency of the engine, and that the rule quoted by him gives splendid results, as shown by the decreased tire wear. On entering the service of the C., N. O. & T. P. Ry. he found the Northern Division, which is very hilly, with grades of 60 feet per mile, 6 degree curves and 27 tunnels stocked with engines which were of the average character as to weight on drivers. These engines were substituted by new ones of practically the same cylinder capacity, but with greatly increased weight per driving axle, and as a result, the roadmaster reports greatly decreased surface wear of rail, and he himself finds the wear of tires much reduced. He believes this has been attained by reduction of slipping, on account of increased weight on drivers.

Mr. Twombly states that engines in which the ratio of weight on drivers to tractive power is above the average, give better results, the wear and tear of machinery being less, and life of tires prolonged.

Mr. Copestake says he generally takes the ratio of cylinder, and adhesive power about equal, but, if any thing, would give an excess, not exceeding 10 per cent., to the adhesive power.

To illustrate the difference in cylinder dimensions, when calculated by the various rules recommended by the gentlemen who have expressed their views on the subject, the following figures are of interest:

Data: Passenger engine. Stroke of piston, 26 inches. Mean diameter of driving wheels, 61 inches. Weight on drivers, 60,000 lbs. Boiler pressure, 160 lbs.

Barnett. $\sqrt{\frac{60{,}000}{5} \times 61} \div 134 \times 26 = 14.5$ in. diameter of cylinder.

McGrayel. $\sqrt{\frac{60{,}000}{6} \times 61} \div 85 \times 26 = 16.6$ in. diameter of cylinder.

Meehan. $\sqrt{\frac{60{,}000}{6.17} \times 63} \div 90 \times 26 = 16.2$ in. diameter of cylinder.

Twombly. $\sqrt{\frac{60{,}000}{2{,}000} \times 5 \times 198} \div 4 \times 26 = 16.9$ in. diameter of cylinder.

Copestake. $\sqrt{\frac{60{,}000}{5} \times 63} \div 101 \times 26 = 16.9$ in. diameter of cylinder.

Webb. $\sqrt{\frac{60{,}000}{5} \times 63} \div 101 \times 26 = 15.67$ in. diameter of cylinder.

Proposed rule. $\sqrt{\frac{60{,}000}{4} \times 61} \div 136 \times 26 = 16.1$ in. diameter of cylinder.

In the consideration of this subject, one has to deal with two indefinite quantities, namely the mean effective steam pressure in the cylinders, and the co-efficient of adhesion; and both of these have to be assumed before any calculation can be proceeded with.

The first, or mean effective cylinder pressure is of course, primarily governed by the boiler pressure, and is secondarily subject to alteration by point of cut-off and speed—it is assumed that the engine is worked with the throttle wide open, and that the steam passages are of proper dimensions, otherwise the pressure will be influenced by these causes.

Few railways are free from grades which necessitate engines being worked to a greater or less extent, nearly up to their ultimate capacity, and in the event of starting on such grades, as well as from stations generally, of being worked full power; hence it appears proper that the mean effective cylinder pressure should be placed sufficiently high to cover such cases, and your committee are of opinion that 85 per cent. of the boiler pressure be considered the M. E. C. P. in the formula.

The second indefinite quantity, or the co-efficient of adhesion varies as the condition of the surface of the rail changes, and according to Molesworth, from $\frac{1}{3.7}$ to $\frac{1}{11.2}$, the former being due to a perfectly clean and dry rail; the latter to a slightly moistened, or frosted rail. In different parts of the world it is doubtless possible to find places where the average coefficients for the year will vary to such an extent as to warrant special allowance being made to suit the circumstances; but in the United States, it may be safely stated that exceptional climatic peculiarities, sufficient to justify any material deviation from a standard rule, do not exist.

As passenger engines are worked so as to produce a M. E. C. P. of 85 per cent. of the boiler pressure, for a very limited fraction of their total mileage, it would appear not improper to use the co-efficient *one-fourth*, or that due to a dry rail, for calculating the proportions of passenger engines.

Freight engines being worked to their ultimate capacity to a very much greater extent than passenger engines, it would be consistent to increase the co-efficient to say $\frac{1}{4.25}$; and in the case of switching engines, generally worked full stroke, a co-efficient of $\frac{1}{4.5}$ would be required to obviate the excessive use of sand, to prevent slipping on the more or less greasy rail generally encountered in yards where this class of engine is employed.

An inspection of tabular statement herewith shows that among engines of recent construction very great variations in their relative tractive power and adhesive weight exist.

In the case of American passenger engines, and using the formula recommended by your committee it is found that the N. Y., L. E. & W. mogul engine built by the Baldwin Company has an excess of adhesive weight of 26,600 pounds, or 28.7 per cent.

The eight wheeled engine built by the Mason Works shows an excess of over 12,400 lbs., or 22.3 per cent.; while the Lake Shore and Old Colony eight wheeled engines are deficient in the same respect to the extent of 6,500 lbs., or 9.2 and 9.5 per cent., respectively.

Among foreign passenger engines, the Belgian State Locomotive has an excess of adhesive weight of over 20,000 lbs., or about 46.5 per cent; the New South Wales Mogul, an excess of nearly 16,000 lbs., or 25.2 per cent.; while the Great Northern express engines, with 91½ inch driving wheels, are deficient to the extent of 12,600 lbs., or over 24.8 per cent.

Among freight engines of American build the variations are not so great. The Union Pacific Wood Consolidation engine has an excess of 18,900 pounds, or 21.8 per cent.; the Baltimore & Ohio Mogul an excess of 12,500 pounds; or 16.7 per cent.; while the Baldwin Decapod shows a deficiency of 18,300 pounds, or 12.5 per cent.

Of foreign freight locomotives, the six wheels coupled engine of the Great Eastern Railway has an excess of 16,200 lbs., or 24.6 per cent.; while the Lubs Consolidated engine, built for Brazil, has a deficiency of 14,000 lbs., or nearly 14.3 per cent.

Of switching engines, the Brooks six-wheeled switcher has a deficiency of 13,900 lbs., or 17.4 per cent.

Your committee recommend, for general purposes the use of the following formula :

$$\frac{d^2 \times S \times P \times 0.85 \times C}{D} = W$$

D = Diameter over tires when half worn.
d = Diameter of cylinder.
S = Stroke of piston.
P = Boiler pressure.
W = Weight on driving wheels.

C = Co-efficient for adhesion { $\frac{1}{4}$ for passenger engines. $\frac{1}{4\frac{1}{2}}$ for freight engines. $\frac{1}{5}$ for switching engines.

Should extreme economy in fuel and water consumption be considered imperative, and of greater importance than additional cost of superheaters and steam jacketed cylinders, and maintenance of same, a considerable increase of cylinder power would be admissable, so as to allow the average work to be performed with a correspondingly earlier cut-off, and greater ratio of expansion.

The unsatisfactory results, however, obtained with the ordinary link motion from the wire-drawing of steam, when cut off much earlier than at 25 per cent. of the stroke, point to the desirability of using some other type of valve motion, when the extreme practice above referred to is contemplated.

Your Committee beg to thank members of the Association and others who responded to the circular, for information used in the preparation of this report, which is respectfully submitted.

CHARLES BLACKWELL,
F. L. WANKLYN,
T. E. BURNETT, } Committee.

Mr. Charles Blackwell explained that in order to make the matter on hand clear to members he had got a table printed giving a few dimensions and weight on drivers of a few locomotives of well known make.

Mr. Hickey found it difficult to arrive at the proper proportion of cylinders, driving wheel diameters and weights thereon. We have on our road two classes of 17 × 24 inch locomotive. One of these, the lighter, weighs on the drivers 51,000 pounds, or a total weight of 12,750 pounds per wheel. The other class, the heavier, has a total weight on the drivers of 56,000 pounds, or a total weight of 14,750. The diameters of these wheels is 62 inches outside tire and, carry a boiler pressure of 140 pounds. We find the heavier of this class haul, on an average rail, 30 net tons, or a car and a half more than the lighter ones, though they wear the tire evidently as much as the lighter, for the reason that if they should slip it causes a greater wear. The lighter ones use fuel to a greater extent than the heavier. We use on our road an average weight of about 16,000 pounds per wheel, 62 inch wheel, 17 × 24 inch cylinder, and carry a boiler pressure of 140 pounds. For a 56 inch wheel we use a total weight on drivers of 64,000 pounds, or a weight per wheel of 16,000 some odd pounds. When we exceed that we find the tire wears very fast; and that should be a maximum load for driving wheel. When more weight is desired it had better be placed on more wheels than four.

Secretary Setchel : There is one point in the report that has been contrary to my experience. It is stated that, "nevertheless within the narrow limits permitted, the larger the cylinder the more economically the locomotive can be worked in the matter of fuel consumption." I have known a great many cases where that idea seems to prevail. One case where the master mechanic thought it only necessary in order to have a big engine was to take off cylinders and put on a larger one; then when harder work was to be done the big engine was hauled out and invariably failed to do the work.

A cylinder far beyond the boiler capacity to supply you steam runs down. I think that it is not true that the larger the cylinder the more economically an engine can be worked, because when steam falls the consumption of fuel increases. A smaller cylinder better filled would be far more economical.

Mr. Barnett: The sentence quoted by our worthy Secretary comes from myself and is hardly complete, seeing I qualified the statement. It refers to using large cylinder capacity, not with the purpose of getting an increased power out of the engine, but in getting increased economy in the use of fuel, because the larger cylinder gives the opportunity of a larger grade of expansion. But under ordinary conditions of practice an excessive expansion of steam is not economical, because you admit in your cylinder at high temperature, and in expanding to low pressure you cool down the walls of your cylinder and on the admission of steam into the cylinder, a large proportion is at once condensed; then when the cut off occurs evaporation commences at the same time. This water is evaporated and therefore interferes with the perfect utilization of the heat contained in the steam. If the steam were a perfect gas that effect would not exist. But steam is not a perfect gas, therefore if you cool your cylinders too low by a perfect expansion you fail about realizing economy in your fuel bill. The sentence is qualified, by "the cylinders being clothed or even steam jacketed." Certainly after you have got up to the limit of cylinder capacity which is given in that report no increase of power can be obtained by lengthening or increasing the diameter of your cylinder. The whole question really turns on certain assumptions and because the assumptions of the various persons are different the formula when applied gives various results. In that question on the point of cut-off there are various pressures assumed. My own assumption was this: that the steam in getting from the boiler into the cylinders loses a certain amount of pressure. In many of our old engines the falling pressure was 17 per cent. No person to day should build an engine in which the falling temperature is more than 7 per cent.

Mr. Sinclair : It a is hard matter analyzing a report of that kind as it is being read. To get hold of it properly one needs to take it and study it out, consequently it is hard to discuss the report intelligently now. One of the most valuable features about it is likely to be that it will prevent the over-cylindering of engines to a great extent. Those who are designing locomotives, if they take up the formula given it will cause less cylinderizing in the future than in the past. If you have a recognized formula—if the Master Mechanics' Association says, "There is a proper design for a locomotive; if it is deviated greatly from you will have an expensive engine"—it will stand in good stead to many men in that department. Very often instead of adding an inch to the diameter the same result would be obtained by adding a little to the pressure of the boiler. The material is at the hands of every designer or builder now to make a particularly strong boiler, and he can use high pressed steam. Take an engine using steam of 100 lbs. boiler pressure, that is particularly low. Suppose that engine to have cylinders 20 × 24. Now, take and raise your steam to 145 pounds, and apply it to an engine with cylinders 16 × 24, and it will do as much work as that with the large cylinders, and there will be a much smaller area of cylinder surface to waste power by extra friction and steam by surface that acts as a condenser, and the cylinder is a more perfect condenser than is generally understood. As regarding this matter of cut-off with locomotives, we never reach the point of cut-off where the expansion is a detriment to the engine. In the most economical engines in use they expand the steam to 8 or 10 times. The locomotive never expands it 4 times, or very rarely. Your expansion taking it at the end of a stroke, is only 4 times and cutting off at 6 inches the release will take place at 16 inches, so you really have no more than two expansions. I cannot see from all the indicator diagrams I have examined that the expansion is so great as to cool the cylinders enough to be detrimental.

Mr. Lauder : I would like to say just a word in affirmation of Mr. Sinclair, and that is, the large high pressures. That doesn't strictly come within the discussion on the report just read, but I want to say that my observation, for the past year at least, in carrying high pressure is, that it is one of the things we have got to come to if we want to get greater power and greater economy. We are carrying now on some engines, as high as 170 lbs. It is very much better to use smaller cylinders and carry higher pressure than to enlarge the cylinders and carry lower pressure. The bane of the engines in America is small boilers in comparison to the size of the cylinders. We have steel tires, steel rails, better road bed, and there is nothing in the way of doing this.

SYNOPSIS OF REPORT ON TRACTION INCREASERS.

The committee on this subject consisted of Messrs. R. H. Briggs, D. D. Shaver and T. J. Hatswell. A circular of inquiry was issued. The report consisted principally of thirteen answers, and very little information of any value was elicited. Mr. James Meehan had tried traction increasers and did not believe in them. He believed that using the weight of the tank for the purpose put an unnatural strain on the frame of the tender and engine, besides requiring too much attention from engineer as regards fluctuation of coal and water constantly going on. If the driving springs are arranged to carry with flexibility the ordinary weight of engine they would be too light to carry the additional weight transferred by a traction increaser, and if heavy enough to meet this increase they would obviously be too rigid for normal weight of engine.

Mr. Lauder had tried several traction increasers and abandoned them because he considered they were worthless.

Mr. Mackenzie had tried one of Dees' patent, and advised its use on all eight-wheel engines. Cost of maintenance for two years was nothing.

Mr. Barnett thought they might be of use on a tank engine or pusher too light for her work. He would not think of applying the device to a new engine, and considered the theory a mistake.

The committee had no opportunity to investigate any device except the Dees. Mr. R. H. Briggs, chairman, had used this device and obtained from 10,000 to 15,000 pounds extra weight on the drivers at will, the advantages of which were apparent. The report closed by recommending the continuance of the subject for another year.

Mr. Briggs could not realize why a traction increaser applied to an engine known to have too little weight on drivers was not of benefit.

Mr. Lauder objected to having the committee continued. Thought there was not enough in the subject to warrant its being continued. Devices of the kind have been tried by the majority of roads in this country and thrown away as of no earthly use.

Mr. Mackenzie had one traction increaser on his road and it certainly gave good results.

President Johann thought a traction increaser was an attachment to a locomotive for which there ought to be no earthly necessity.

Mr. Hickey favored traction increasers. Thought that to carry full weight all the time for the adhesion needed when engine was working at its maximum capacity was putting an excessive weight where it was not needed. Wanted to have the means provided to supply the greatest adhesion at the times it was needed.

Secretary Setchel did not think it was proper to design a locomotive so that a traction increaser would be necessary. But every engine now uses a traction increaser in the shape of a sand-box, and that means of increasing traction often does a great deal of damage. Thought there were cases where the traction increases under consideration were an advantage.

Mr. Sinclair moved that the report be received and the committee discharged, which was eventually agreed to.

REPORT ON PISTON PACKING.

(This report will be published in a future issue of the N. C. & L. B.)

Mr. Sprague did not see any necessity for the practice of turning a ring to a circle different from the cylinder. Thought the practice extremely unmechanical. He chucked the rings after they were cut and trued them up.

Mr. A. Griggs (Providence & Worcester) cast his rings in hard metal and turned them to size of cylinders.

Mr. T. M. Gentry (Richmond & Danville) followed both practices and gets good results from both. If they are not turned true to the cylinder there will be two points of wearing surface, but they soon wear to a fit, and he did not believe it mattered much which practice was followed.

Mr. Lauder did not think it mattered much whether piston packing was sprung on to the solid head or slipped on to a bull ring and held by a follower plate. As to turning the rings, probably the most mechanical way would be to rough the ring first, then put it on a chuck and turn it to the circle of a cylinder. He mills the rings diagonally in cutting them and lets them go at that. Does not think any steam worth mentioning is lost by leakage through the joints. Discussion closed.

DUTY OF CYLINDER OIL.

The discussion of topical subjects being in order, Mr. Burford (Memphis & Charleston) asked what is a good average run to a pint of cylinder oil? I think 75 miles is a good average; some say they run 125.

Secretary Setchel : I do not really get the drift of the gentleman's question. As I understand him he asks how much oil is needed to run 75 miles. (Mr. B. repeated his question.)

It seems to me that that would depend upon the condition of the train, the engine, of the valve surface, the cylinder surfaces, how much water carried, and rather more than anything else, upon the man that is running the engine. If an engineer running for me should not be able to come up to the average run on a pint of oil, I should endeavor to find out the reason. An engine running under steam continually might and would run a great deal longer than an engine shut off. On a hilly road the engineer would have to give his engine a little oil on every grade.

Mr. Mackenzie: Mr. B. does not give us his experience. My experience is that running 116 miles on a passenger engine we have just as good results as if we had run ten. We have one engine that has run as high as 232 miles on a pint of oil.

Mr. Hatswell. I would like to ask Mr. MacKenzie what appliances he used on his road for lubricating the cylinders.

Mr. Mackenzie answered that he used the Detroit and the Northern automatic lubricators. We have run as high as 360 miles to a pint on a test but do not follow it up. Our average though is 59.

Mr. Briggs : I found a great deal of trouble with the use of cylinder oil until I began to use the automatic lubricator. It was customary on the road I was connected with for the engineers to buy oil rather than be defeated while in competition with one another. In September of the year that I commenced making comparisons, our valve oil cost us 24.3 cents per 100 miles; in October of the next year we commenced using the automatic lubricator and it reduced that to 15 cents per 100 miles. We first need the Galena oil, the last oil, the valvalette oil, I think it is called, this was in 1884 or 1885.

President Johann's experience had been that the mileage for oil and coal did not always represent the greatest economy when the apparent cost was lowest.

PRESSURE OF STEAM.

Mr. Lauder : I think perhaps a little discussion on this question of the desirability of carrying the increased pressures would be as profitable a subject as we can now take up. There is a feeling among the progressive engineers, both locomotive, marine and stationary, that we should carry higher pressure. This has come about largely by the enormous reduction of expense in operating marine engines where the cylinders have been compounded. To do that economically you must start with high pressure. How far that principle can be carried out is an open question. There are good arguments for it and some against it. I do not believe it is economy to cut off steam on a 24 inch stroke cylinder, shorter than 6 inches with the ordinary valve motion. We have gone along for years at about 140 pounds. A good many have got up to 150, a few have got more than that. Mr. Underhill has been carrying 160 pounds with, it is claimed, good results. Mr. Stevens, of the Lake Shore, has put to work passenger engines carrying 180 pounds. I have got up to 175 and I think with good results. The fact is the transportation department is calling on us every day for greater duty from our engines. Cars are built heavier and we are expected to haul more tonnage than a few years ago : the tendency seems to be in that direction. The consequence is we have had to increase our engines. We have them now up to the maximum weight and size. It is impracticable, it seems to me, to get much above the weights we have now on our heavy passenger and freight engines. The question is how to get more power without increasing the weight. Some say the power of passenger engines is dependent on their adhesion. That is true to some extent, but there is very little difficulty from the slipping. The power of a passenger locomotive is just her capacity to make steam. She has adhesion enough. I am speaking of a good modern engine. There are very few engines that will hold steam while cutting off over ten inches. If you can get a boiler in the engine that will carry higher pressure you have got the engine. In my own practice one of the engines that is carrying 175 pounds of steam is pulling our boat train. It is composed of sixteen cars, eleven being sixty feet long. We never have had an engine on that train that would make the steam to pull that train over in proper shape until these engines were put on. These engines have a large boiler, nearly 1,500 feet of heating surfaces, that enables them to make steam freely. When we strike a heavy pull we can not have engines that will go down, down, down to 100 or 80 pounds. I claim a boiler can be designed to carry 200 pounds of steam as safe as one that can be built to carry 100 pounds.

Mr. Howison saw no reason why steam of 200 lbs. pressure should not be used, and wanted it superheated at that.

Mr. H. M. Whitney asked if Mr. Lauder had trouble in lubricating valves and pistons.

Mr. Lauder answered that he used automatic lubricators and balanced valves, and there was no trouble from want of lubrication.

Mr. L. M. Ames moved that it is the sense of this meeting that it is not desirable to carry steam over 135 pounds pressure for freight engines.

Mr. Hickey thought the pressure to be carried should depend on circumstances. There was first the kind of boiler in use, and then the weight on the drivers and size of cylinders. Agreed with Mr. Lauder that increase of boiler pressure was preferable to increase of cylinder. Had some experience with superheated steam and found it made lubrication so difficult that loss resulted from its use when the expense of the extra appliances and the extra friction were taken into account.

Mr. Lauder said that high pressure of steam was not so important for freight service as it was in passenger locomotives.

Mr. Burford spoke in favor of high steam pressures for all kinds of work where hauling had to be done.

Mr. Sinclair differed from Mr. Lauder as to high steam pressures being more valuable for passenger than for freight service. Freight engines are by far the most numerous, and a great part of the work is done in 12 inches, which admits of no expansion to speak of. Many passenger engines do their work in 6 inches and must already have the steam reduced by throttling to keep them from running too fast. Now take the freight engine that is working at 12 inches and increase the steam pressure 20 or 30 pounds, and you will be able to pull back the lever a notch or two and get the benefit of the increased expansion. It also gives the means of doing a given work with reduced size of cylinders.

After a little more discussion the subject was dropped for the day.

Next business was reading the

REPORT ON PISTON ROD AND VALVE STEM PACKING.

(This report will appear in a future issue of the N. C. & L. B.)

There was no discussion on this report.

President Johann appointed as a committee to select the

next place of meeting Messrs. Wm. Swanston, Clem Hackney and H. S. Kolseth.

A communication was read from the wheel manufacturers asking the Association to appoint a committee to meet with that of the Master Car-Builders' and of themselves to arrive at harmony in matters pertaining to chilled wheels. President Johann appointed the following to serve as such committee: G. W. Stevens, J. N. Lauder and James Meehan.

REPORT OF THE COMMITTEE ON LOCOMOTIVE PREPARATION.

To the American Railway Master Mechanics' Association:

The Committee on Locomotive Preparation appointed to report at this meeting submits the following:

With the view of laying before the Association as a body the practical results of the experiments of such of its individual members as had considered the subject sufficiently in the line of economy to warrant their attention in that direction, and with the further purpose of finding out how far advanced locomotive boiler construction had gone toward providing the means of easy access to such parts of the interior of this class of generators as were the natural depositing points of the impurities that to a greater or less extent are found in all classes of feed water.

We followed the stereotyped practice and issued through the secretary a circular letter of inquiry; the replies to which were not numerically sufficient to justify the assertion that much importance was attached to the subject. This we regret the more from the fact that several of the larger and well-kept systems have in use apparatus in many of their round houses or running sheds for the economical washing of the boilers of their engines in services and the prompt and speedy preparation of the same for duty, a description of which would have been both interesting and profitable to a large proportion of our members. It is, of course, perfectly understood that the conditions of washing very largely, even on lines of moderate extent, and what would prove an effective means of removing the class of matter deposited by the feed water in one locality is found entirely inadequate to handle that in another.

The difference in the interior construction of boilers operated in the same service and the wide variation in the means provided for access to the same, is the committee's excuse for branching out as it did in its queries.

From the answers received to the questions on these points, they are led to suggest that the boiler committee of 1885 be reinstated and their labors continued in the line as given in that part of their report (1885, page 44) that refers to the removal of scales and mud by water under heavy pressure; for, judging from the experience of most of those who saw fit to answer our questions, "As to what facilities had been provided for the easy access to the interior of their boilers," we are led to believe that this part of boiler construction had been somewhat overlooked, and the ready means of getting at that portion of the deposit that is left on crown sheets and among the stays, around the tubes and against the front flue sheets are seldom provided, most constructors seeming to think that a mud plug or two in the corners of the fire-box legs will answer the requirements, and that the removal of deposited matter that had been hardened by the heat, by the means suggested, would not be satisfactorily performed on account of the inability of the washer to direct the volume and force of the water to those points where most needed.

The wide variation of the time which the different qualities of water used permits in the periods of washing render any suggestions in this direction impracticable; where such conditions as require washing every third trip of 125 miles exist, the neighbor who can run for six months or longer without laying up the life or efficacy of the boiler, would not be likely to increase his labor account to meet.

We find that in the majority of instances the periodical system of washing both boilers and tanks is followed, and where engines are brought regularly to the same round house, this would seem the surest way in which to have this done.

The practice, as outlined by Messrs. Meehan (C., N. O. & T. P.), Cockfield (C. & N. W.), Barnett (G. T. of C.) and Gentry (R. & D.), is, in the main, the same, and from all that may be learned, represents the best methods that exist for the purpose of thorough and speedy washing and refilling boilers of locomotive engines and the rapid generation of steam without injury to the iron of same.

We have not been able to learn of any method that is in practical operation of starting the fires in locomotives other than by the use of wood, the cost of which per engine fired (average 25 cents) is not excessive. The use of the electric current or some form of petroleum gases can readily be adopted to ignite a small quantity of selected bituminous coal, the design of which apparatus can only be perfected by actual experiment, the means of which are unfortunately not within the control of any member of the present committee.

On roads that use the fire arch in connection with the baffle plates and extension fronts, so far as we have been able to learn, the only means in use to clean tubes that have become clogged is to knock out the arch brick and bore them out with an augur, the frequency of this operation appearing to depend on how hard the engine is worked, the great difference in the length of time between borings as reported, being offset by the service given.

As this operation involves the loss of a complete set of brick every time it is performed, we would submit it as it stands for discussion. The personal experience of at least two of your committee, leading them to the belief that some more economical manner of accomplishing this is to be desired.

Your committee conclude that with boilers that are constructed with reference to being easily accessible to all their interior parts, the best system for washing out is by means of high service storage tank in connection with a stationary boiler and proper piping for blower and blow cock connections, and the steam boiler washer (of which there are several good ones on the market). The live engine to contribute its steam to heating the storage tank and in return when washed to receive its full of hot water from that source. For firing up, they are of the opinion that the present use of wood is to some extent abused, but aside from its storage and handling it leaves little to be desired from an economical point of view in the majority of sections of this country when properly used in boilers that are filled with hot water and have means provided for artificial draft.

G. W. ETTENGER,
W. H. THOMAS,
T. W. GENTRY,
} Committee.

Locomotive Preparation No. 1.

Mr. James Meehan, C., N. O. & T. P., writes that he uses 20 × 24 Consolidations, 19 × 24 Moguls and 18 × 24 Americans as standards, with soft coal as fuel, soft water as feed, the deposits of which (one per cent.) are mud, lime and magnesia. Engines loaded full for 70 ft. grade.

He finds it necessary to wash passenger engines after making 632 miles, and freight engines 474 miles, the equivalent of four day's service in each case, mud being the main impurity with which he has to contend. Plugs in fire-box legs opposite each arch pipe and under waist of boiler near smoke arch in which to introduce hose.

Jet of cold water at about 30 lbs. pressure he finds efficient means of cleaning his boilers. He considers it desirable to let his boilers get cold between trips, and never permits banking of fires having them cleaned at the end of each trip. He uses the fire arch and baffle plate, and cleans tubes by removing same and using scraper through tubes. Fills his boilers after washing them with cold water, requiring on an average 20 minutes each, and requires one hour to get steam, using ½ cord pine wood, cost 25 cents. Uses Greenwades device for heater and blower. Cost to erect for 16 stalls $87.49. Estimates saving about 20 cents per engine fired.

Cleans tanks periodically at intervals of six months, uses unskilled labor at 12½ cents per hour, supervised by roundhouse foreman; record of same kept by roundhouseman.

Mr. Cockfield (C. & N. Ry.) in a 20 stall engine-house uses two No. 58 Nathan boiler washers, washing 7 engines every 24 hours. These are supplied by an upright boiler 48 × 124 in. at 90 lbs. pressure, which gives 50 lbs. pressure at nozzle through 50 ft of 2¼ in. hose, water being warm when entering boiler, can regulate temperature to any point, and finds great advantage from the use of hot water for this purpose and for refilling boiler when washed. Does not allow steam to be blown off through blow cock, and considers it essential to allow engine to stand two hours after steam is blown off before water is let out; uses oval head pipes and connections to blower, and blow cock to use steam from live engines, or stationary boiler to hasten steaming up. Has let water out of 18 × 24 engine; refilling same, and made steam enough to come out of house in one hour and thirty minutes. Can refill boiler in 8 minutes, and get 50 lbs. of steam in 25 minutes. Estimated fuel consumption to wash out and fire up 330 lbs. per engine.

Mr. Barnett, G. T. Ry. of C., uses 18 × 26 moguls and 18 × 26 Americans as standards. Fuel, soft coal, and every variety of water from hard to softest of brown swamp. Lime being its worst impurity, but can not tell proportion. Loads engine to full capacity for one per cent. grades, washes boilers once a week, or about once every 1,000 miles. Boilers are supplied with brass washout plugs in the four corners of fire-box above foundation ring, in back and front tube sheets and on back head of boiler, also, well up on both sides of shell over crown sheets, enabling washers to reach every point with washout nozzle. Blows steam and water from engine to be washed into a storage tank, to be used from there for filling boilers that have been washed.

Uses pressure of 60 or 70 lbs. on nozzle for washing. Uses live coal from sand dryer to start fire, and trusts to natural draft for same. Does not permit fires banked at terminals. Can not give cost in money, but estimates the saving from use of hot water at from one to two hours.

Mr. Gentry, R. & D. R. R., uses 20 × 24 consols and 18 × 24 Americans as standards. Soft coal for fuel and surface water as feed. Mud is the worse impurity, the proportion being very small. Sees no advantage in mud drums. Makes it a rule to wash boilers once a week. Allows steam to blow off through blow cock, but at reduced pressure. Has to take down baffle plate or arch to clean tubes, but is experimenting with a combined steam and water washer for this purpose. Uses steam from stationary boiler to heat water and work blower of dead engines. Has system of underground attachments for connection of blow cock and blower. Does not use steam from live engine for any purpose. Fires up with pine wood, cost 21 cents per engine. Estimates saving over cold water one-half less than wood and one third of time.

The details of all the replies and such future prints as accompanied them have been sent to the secretary, in whose hands they can be found by any member that may desire to overlook them.

REPORT OF COMMITTEE ON COAL DELIVERY TO LOCOMOTIVE TENDERS.

To the American Railway Master Mechanics Association:

The replies received to circular issued by your committee show that the more common modes of delivering soft coal to tender are, 1st: by shoveling direct from car to tender; 2d: by bucket and crane, and by small tipping or dump-cars (both at level of tender coping), and 3d, by chutes at high elevation.

Shovel and Platform: The cost of shoveling direct from car to tender, and part of the time from car to platform and from platform to tender varies (in one case reported) from 25 to 34 cents per ton, where the output is but from 42 to 55 tons per week, delivered over a period of 16 hours in each of the 6 working days. This large cost is due to the exposure of the men to the rigors of a Canadian winter, also to the fact that the fuel is often frozen to the cars, and to the men not being fully employed. The rate of pay is 12 cents per hour. A maximum rate of delivery is 3 tons per hour per man, but this speed is not maintained, the lifting by shovel of 20 long tons per 10 hours being considered a fair day's work (at medium temperature) for one man on day wages.

Mr. F. J. Brownell (B. & L. Ry.), shovels from platform at level of footplate, delivering 30 tons per day; the cost of labor measuring and delivering, averages 10 cents per ton.

We infer that this amount does not include cost of delivering onto platform.

The Roadmaster's Association we find made a report on "handling coal" for locomotives in 1885, in which they state that of the replies received giving the cost of hauling coal over platforms of different constructions, the maximum was 30, the minimum 11, and the average 19.4 cents per ton.

Crane and Buckets: For delivery by bucket and swing-jib crane, from platform between coal cars and delivery track, little improvement is obtainable, although it is the most common practice in Great Britain and her colonies. An average of the time occupied in fully coaling up one tender is from 5 to 10 minutes; the crane being worked by manual labor, its small buckets (stored on the platform) having been previously filled from the cars by shovel.

Mr. J. M. McGrayel (D., M. & F. D. Ry.) reports that with ¾ ton buckets two men handle 25 tons per day, at a cost of 15 cents per ton. Thus these men shovel and then lift by crane 12½ tons as a day's work, receiving as wages $1.87½ per day.

Mr. J. McKenzie (N. Y., C. & St. L. Ry.) reports an average taken from two stations, showing the cost by crane to be 7½ cents per ton, the rate of pay being 12½ cents per hour, and the rate of delivery 55 tons per day, each man shoveling and then lifting 18 tons per day.

Dump Cars: Delivery by tipping pockets or dumps is shown by drawing No. 12 forwarded by Mr. H. Roberts (C. G. T. Ry.), also by sketches No. 13 and No. 14. These dumps are fixtures, except that they can partially oscillate on a horizontal axis parallel with delivery track; therefore the coal cars have to be moved as they are being unloaded to suit the positions of the dumps, and storage *in situ* is practically *nil* except the coal is handled by shovel three times; hence, when the storage must be arranged for, a variation on this plan becomes necessary, and is reported in 4 cases. It is clearly shown (for the C. R. Ry.) by the three photographs and drawing No. 11 sent by Mr. W. H. Stearns illustrating a dump mounted upon a trestling carriage or trolley. He quotes a daily delivery of 45 tons, costing 14 cents per ton, the rate of pay for four men varying from 14½ cents per hour to foreman at 18¾ cents per hour. This gives a man's shoveling and trolleying capacity at 11¼ tons per day. To check the amount delivered a track-scale weighs the tender before and after taking its supply. The first cost of the low timber trestle shown averages $2.50 per foot run.

Mr. J. McKenzie uses a similar system, the dumps holding 6 tons and dipping to an angle of 45 degrees, costing 8 cents per ton, delivering 74 tons per day, rate of pay 12½ cents per hour. With two men on each shift of 12 hours the rate of pay would be $1.50, and each man would handle 18½ tons.

Mr. J. Strode reports a similar apparatus in use at two points on one division of the N. C. Ry. He says: "The platform and trestle system consists of a raised platform, 200 feet long, parallel with the main track, 32 feet wide and 10 feet above top of rail. Upon this platform is arranged a system of delivery tracks spaced 25 feet apart, at right angles to the main track and extending back the full depth of the platform.

"At a point 8½ feet from the center of the main track is a stop which serves the double purpose of first stopping the car at a given point, and, secondly, of releasing the hook on the back end of truck; then the sudden impact of the truck dumps the coal into the tender.

"Upon this platform also rests a trestle 200 feet long, with an average height of 8 feet 11 inches, and a grade of 9 inches per 100 feet. The approaching trestle is 447 feet long, and has a grade of 4½ per cent. The cars being placed upon the high trestle, the coal is loaded directly into the coal trucks beneath, or dumped upon the platform. In using the platform stock coal, it has to be reshoveled into the coal trucks.

"The truck herein mentioned—a drawing of which (923) accompanies this report—is simply a dump car (with one truck), turning on its short axis. One end of the car is open and the truck is placed under the opposite end. The inside dimensions are 10'8" long by 5'10" wide by 1'10" high. This car when loaded with 3 tons is operated by one man. This system is prefered at stations along the main track, for the reason that when the locomotive stops with its train at the point for coaling, the tender can be loaded in a few seconds. The average cost per ton for January, February and March, '87, was 4.6 cents, employing two men and delivering 57½ tons per 24 hours." This give an average of 28¾ tons per man.

In most cases of delivery by dumps known to your committee, advantage has been taken of a difference in land elevation, thus largely reducing the first cost of the plant, which (considering that it is a quick system of delivery) is not large in any case.

This plan—fully worked out—can be made to suit the varying conditions of an irregular supply (where the coal is in part drawn from coal cars and in part from a storage heap) better and with less cost than most *compromise* schemes: and is shown by sketch drawing No. 222, in which track *A* is used for coal cars fresh from the mine, when their loads are to be delivered into dumps for immediate locomotive use: track *B* within the storage shed is for delivery from cars into the sheltered storage heap; and track *C* (if required) for delivering supplementary stock, in case the shed should not prove large enough to contain the amount to be stored at any exceptional season. If the shed be narrow, outside tracks *A C* only are needed for delivering stock to be stored.

It should be understood that the light rails for the trollies (running at right angles to the main tracks) are flush with and cross over all three tracks *A B C*, so as to permit trollies to be run back to supplementary stock *D*.

Chutes: The general and favorite mode of delivering, where large amounts of coal per day have to be handled, is by chutes.

The style of chute shown by Mr. W. H. Harrison (B. & O. Ry.) on drawing No. 15 is the most expensive in first cost, especially where the land (required for the long approach) commands a high price, but it has the advantages of a reasonable amount of storage, is worked by steam or locomotive power, and delivers 115 tons per day at the low cost of 4¾ cents per ton, without (we infer) it being worked up to its capacity.

The drawing shows a center high level track on open timber trestle, carrying drop-bottom cars delivering their coal onto a lower platform, on each side of which are the pockets so arranged that delivery can be made into tenders on both sides of the structures. The pockets are very deep, of quick pitch, and marked at the sides to indicate the weight of the contents at each given level. The aprons are of a much flatter pitch than the pockets.

The Kerr chute, as used by Mr. J. Meehan (C., N. O. & T. P. Ry.), is shown by drawings Nos. 1, 2 and 3; as used by Mr. C. E. Smart (M. C. Ry.) by drawing No. 16, and drawing No. 6 gives the earlier practice of the C., M. & St. P. Ry. Mr. Kerr informs us that his patent right has run out, but he will supply a full set of plans and detail drawings for $50.

The Clifton sluice is shown by drawings Nos. 17 to 21, and is strongly indorsed by Mr. T. B. Twombly (C., R. I. & P. Ry.), and also by Mr. C. Latimer in his communication to the Roadmasters' Association in 1885.

The distinguishing characteristics of the Kerr and Clifton chutes are: First, the way in which the aprons are secured by latches or catches; second, the balancing of the aprons, and third, the use of a hinged or flap door to form the front of the pocket. The G. T. Ry. experience coincides with that of Mr. Don. J. Whittemore (C., M. & St. P. Ry.) that this latter feature (flap front door) is not necessary, increasing both first cost and repairs.

However, the more recent device in some of the Clifton chutes, of an inside division or intermediate flap, permitting the contents of a large pocket—say 6 tons capacity—being delivered in definite proportions into two small tenders, appears to be a device worthy of note; also balancing the apron by wooden lever is probably cheaper and less liable to breakage—or other failure—than the use of chains, pullyes and loose balance weights; although nothing but actual experience will actually settle such questions.

In designing chutes, the angle for bottom of pocket and apron has always been a troublesome point to settle. A comparison of the various drawings shows the Meehan (Kerr) to drop 45 deg. from the horizontal, the Clifton 34 deg., the R. & D. 55 deg., but the apron only 37 deg., the Smart (Kerr) 33 deg., the C., M. & St. P. Ry. (Kerr) 30 deg., their new style being 38 deg., and the G. T. Ry. 36 deg. The average—taken over the seven aprons—showing a dip of 36 deg.

The cost of labor for delivering coal by chutes is given by Mr. Smart at 7 cents per ton. Allowing for interest, depreciation, renewals and repairs at 20 per cent. per annum, on the first cost outlay of $4,000 for the chutes complete, the cost of delivery per ton will be increased almost 1½ cents, or to a total of 8½ cents per ton on an actual delivery of 175 tons per day. The first cost of his set of 40 chutes averages $100 per pocket. The cost, as given by Mr. Meehan (C., N. O. & T. P. Ry.), for delivery by chute, using drop-bottom cars and high trestle (somewhat similar to the B. & O.) in the slack season when a minimum of 18 tons per day is delivered, is 6 cents per ton, with labor at 10 cents per hour. Allowing the customary 20 per cent. on a first cost of $5,500, and using only the minimum output, it would increase the cost of delivery by 16½ cents per ton; but it should be borne in mind that the business in the cotton season far exceeds the average, and that the permanent works are adequate to deal with an expected permanent increase in business, so that they can readily handle 320 tons per day every day in the year (equals 116,800 tons per annum), which if divided into the 20 per cent. adds but 1¼ of a cent per ton to the labor cost of delivery, and the labor cost would also be lessened.

It is probable that in a Southern climate the outlay for repairs and renewals to a wooden structure is far less than in the damp and frosty climate North and East; but the same figures for renewals and repairs have been here used to facilitate comparison.

Horse and Cart: For delivery into chute-pocket by horse and cart—the coal to be shoveled from either car or storage heap—annual contracts are made at 10, 12½ and 15 cents per ton; more than 40 tons per day being delivered when the price is as low as 10 cents. However, it comes directly under our notice that one man and horse can day by day handle 30 tons in less than 10 hours, receiving 7 cents per ton; the rarity being of easy grade, of low available height, and the haul distance short.

Mr. Allen Cooke (C. & E. I. Ry.) describes a chute (probably the Kerr) which he is using at four coaling stations, delivering 230 tons per day, requiring seven men at 12½ cents per hour to handle, making the average cost per ton to deliver 3.78 cents, to which must be added 1¼ cents (or say in all 5 cents) for "interest, etc.," at 20 per cent. on a first cost for plant of $5,031.

This is the lowest figure for chute delivery given in any reply we have received, but it comes no way near the low figures given in the Roadmasters' Committee's report, who say: "Where coal chutes are used we find a maximum price per ton of 9 cents and a minimum of .045, (with) an average of .074 cents per ton, (showing) an average (saving) of 12 cents per ton in favor of chutes. The time consumed in taking coal from chutes, 1 minute, and from other devices, 12 minutes, (showing) a saving in time of 11 minutes for each engine coaled in favor of chutes, and where 3,000 tons of coal is handled monthly, we find a saving in favor of coal chutes of nearly $4,500 (per annum) over other devices."

American Crab Crane: An ingenious, cheap and prompt mode of delivery is that used by Mr. E. B. Wall (P. C. & St. L. Ry.) at Columbus, O., and illustrated in the *Railroad Gazette* (April 1, 1887, p. 214), see drawing No. 25. It comprises a self contained steam crab-crane, on a trolly having longitudinal movement over the whole length of an overhead traveling girder spanning three parallel coaling tracks, the girder having motion on rails carried on trusties 25 or 30 feet high, one on each side of the coaling tracks.

The coal shipped from the mine in ordinary cars is shoveled into 2¼-ton iron buckets at ground level, and the crane lifts one of the filled buckets and moves it over the tender, when the latch securing the hinged bottom is released, and the contained fuel falls into the tender. Mr. Wall says: "I do not think that this form of coal wharf is the best for all purposes. Coal can be loaded more cheaply where drop bottom cars are used and the wharf arranged accordingly. At Columbus, however, we receive our coal in straight bottom gondolas, box and stock cars. At certain periods of the year we have to carry a supply of coal

on the wharf, at other periods the coal can be loaded direct from the cars into the buckets. In designing our wharf we had to consider these conditions. When the capacity of this wharf is taken into consideration with its first cost, I consider it a very satisfactory solution of the problem. The cost of maintenance of the structure is very light, and it can easily be renewed at any time without interfering with the operation of the wharf.

"The large timber constructions in general use are very expensive to maintain; they have to be renewed every six or seven years, and while with the drop-bottom cars they can be made to handle coal more cheaply per ton than the crane arrangement, nevertheless, when all items are taken into account, I think that the showing would be about even."

The capacity and cost of operation at Columbus is as follows:

Capacity of bucket, in lbs	5,000
Average weight delivered, per engine, in lbs	7,000
Probable maximum capacity with 50 buckets and trestle at present length:	
Maximum number of buckets dumped per hour (tested)	2[illegible]
Actual working hours (handling buckets)	24
Maximum number of buckets per month	1,500
Maximum number of tons per month	31,500
Allowing each bucket full of coal, also a loss of 20 minutes in time for each 50 buckets handled for the purpose of supplying crane boiler with fuel, water, etc., which equals about 3 hours in 24. Then:	
Present delivery in tons per month	9,120
Present delivery in buckets per month	5,132
Cost of plant	$7,706.00
Wages of (2) engineers per month, at 18 cents per hour	129.60
Wages of (.2) coal-heavers per month, at 12 cents per hour	518.40
Wages of (2) men* dumping and signaling to cranemen, per month at 12 cents per hour	86.40
Foreman of wharf (1) per month, at 13 cents per hour	46 80
Fuel, oil, waste, water, etc., per month	12 50
Repairs to apparatus, per month	5.00
Interest on investment, per month, at 6 per cent. per annum.	38.50
Total operating expenses, per month	$837.20
Cost of coaling, per ton, in cents	.091
Cost of coaling, per engine, in cents	.3155
Not taking interest on plant into consideration, per ton, in cents.	.087
Probable cost per ton, at maximum capacity	.058
Average length of time for coaling in engine	6 minutes.

It is possible that Mr. Wall's original plan might be improved by the use of a "Gantry or Goliath Crane," as used in Europe, described and illustrated in Mr. G. J. Appleby's paper on cranes, read before the American Society of Civil Engineers, Oct. 17, 1883. (See Proceedings, p. 374.) This dispenses with the trestle, as the whole crane with its long vertical legs traverses on tracks at ground level. The first cost of the crane would be increased, and there would be an increase in the power required to move it but the system and storage could at a few hours' notice be indefinitely extended at the slight cost of increasing the length of the tracks.

Locomotive Hoist: Another special apparatus is that designed by the late Mr. J. B. Collins, of the P. Ry., illustrated and described on cutting from *The Railroad Gazette* (see drawing 24). Mr. Strode, of this committee, says it is preferred at Elmira because of the small yard room there available for coaling purposes.

The rate of delivery is one truck load of 2 tons in from 70 to 80 seconds, and 4 tenders have been loaded with 2 trucks each, in 15 minutes and 25 seconds, an average of 3 minutes 51 seconds each. This includes the time of attaching and detaching chain from the locomotive, and clearing the track for another locomotive to enter.

The cost, averaged over the first three months of '87 (when the apparatus was not worked up to its capacity), is 7 9-10 cents per ton, delivering at the rate of 534 tons per day, and requiring three men per 24 hours at 12 cents per hour.

Structional Economies: Our circular did not include any queries as to economies in design or construction of plant, but a few notes can be made from the accompanying chute drawings.

In manufacturing aprons, the G. T. Ry., the C., N. O. & T. P. Ry., and apparently the B. & O. Ry., use plate iron, stiffened with angle-irons; all others use timber aprons faced with sheet iron.

Earlier in this report we have noticed an instance of the use of levers instead of weights for balancing the aprons. The C., M. & St. P. Ry., who use chains and weights, have an extra weight of oak which the chain lifts just as falling loaded apron has to be brought to a state of rest. This may be easier in its action and cheaper than the additional iron weight usually used, but can not, we think, equal the use of an additional length of stout chain that is lifted only at the last moment, giving a gradually increasing resistance to balance (neutralize) the cumulative energy of the falling apron.

In designing the timber framing (see drawings Nos. 1 and 2, by Mr. Meehan) there may be a reduction in scantling and a saving in first cost if the chute or pocket be carried well over the outer frame or beyond the line of posts, as it permits the transverse timbers to be shorter, and the posts can thus be the more completely utilized in carrying the great weight (due to the stored coal, the coal cars and sometimes a locomotive) that comes upon the structure.

The intermediate flap door of the Clifton pocket, dividing it into two chutes, would add about $30 to the cost of each 6 or 7-ton pocket.

On the B. & O. Ry., drawing No. 15, it may be noticed that the joint at hinge between bottom of chute and apron is open or only covered by a wire screen, and a guide for the dust and a dust-box inside the timber frame is provided for the fine slack in a way similar to the screening apparatus often used with hard coal chutes. The dust-guide is so finished at top as to form an effective support for the apron in its lowest position.

Conclusions: To summarize, it may be said that with regular coal supply from mine in drop-bottom cars, the cheapest and most rapid delivery is by using high central trestle, from which the coal is allowed to gravitate into dimensioned chutes, and from the chutes gravitates into tender.

When sufficient land can not readily be obtained for the long ramp (grade) this system requires, the economy in labor and slight injury to fuel is so marked under this system as to suggest the advisability of lifting the loaded mine cars, vertically (by some form of power elevator) up to the level of track on top of the high trestle.

For a *compromise* system where the daily fuel issues are sometimes taken from cars and sometimes from store heap, either the tipping pocket on truck or chute filled by horse and cart may be used, or if the amount to be stored and lifted from heap be not large, an overhead girder crane, as used by Mr. Wall (drawing No. 25), will do. If a Goliath crane be used, the storage is practically limited only by the land obtainable.

For leisurely delivering comparatively small amounts, the platform, or better still, direct shoveling from car to tender, is as cheap as any manual labor system known; and if it is desired to lessen the time actually occupied in delivering to tender, a hand crane and buckets on the platform will do so with but little outlay, and but slight increase in cost over direct shoveling; in fact, if the use of buckets insures the men being steadily kept at work, the cost per ton may by use of crane be lessened.

In closing this report, we would say that it is apparent, from information received by your committee, that the railway department most keenly interested in the cheap and prompt delivery of fuel, viz. the mechanical department, is not the many of the railways of this continent usually intrusted with the design, manufacture or working of the plant required.

This is a mistake, and in the worst case that has come under our notice, resulted in the extravagant charge against the department of $1 25 for each ton of coal delivered.

Since the foregoing was written and approved by the Committee we have received drawings Nos. 26, 27 and 28, illustrating Mr. D. S. Dockstader's side-dump coal-car and oscillating apron, designed to deliver coal direct from car to tender without the use of shovel, and therefore at minimum expense.

It will be seen from an examination of the drawings, that the floor of the car inclines upward from side-sills to center at so quick an angle that, when one of the side flap doors (hung from top-rail) has its latch released, the coal will freely slide out.

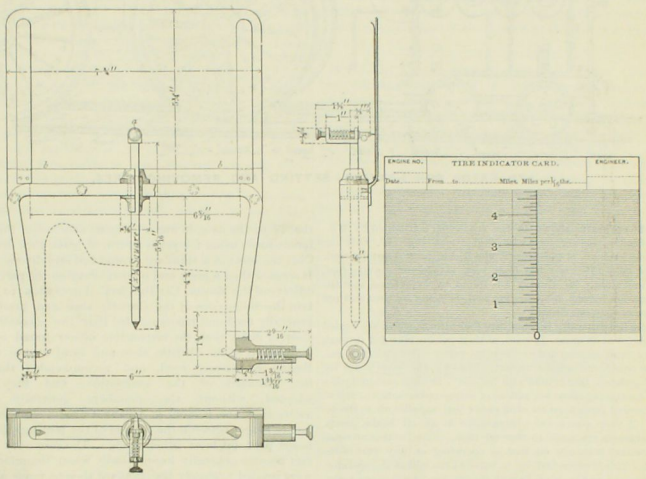
There are five compartments and five doors on each side, so that each of the ten pockets in a 30 ft. 30-ton car hold two tons.

A ramp and trestle 11 ft. 4 in. high are needed to lift the coal cars above the level of tender, and vertical posts carried up on both sides of the horizontal part of this trestle support metal hinges upon which are swung aprons (of the width of the car pockets), whose purpose it is to guide the coal into the tender. Under normal conditions the aprons stand upright and in line with the posts, thus clearing both tender and car, but the pulling on a short rope swings the apron into position for acting as a guide, and the pulling of a handle locks it there, after which the latch securing the lower side of flap door on car is released.

The first cost for plant and the daily outlay for labor are very light when this system is used, its chief defects (aside from the large yard space taken for the three parallel tracks) being the comparative uselessness of the cars for ordinary freight service on return trip to mines, so that the cars would probably only earn revenue on half their total mileage—if hauling company's fuel can by stretch of language be said to be revenue earning service.

favored with the offer of applying this invention to one train of cars free of charge, no royalty to be asked unless the invention is perfectly satisfactory.

While entertaining the warmest admiration for the embraces of generic principles in which ladies of inventive tendencies may be expected to show expertness, we really cannot extend our approbation to the proposed means of heating cars. In literature and in art women are noted for the protracted ways they follow to reach a desired end. The devious wanderings are often made beautifully attractive. That will not do, however, in mechanics, where the direct means of reaching an end are the best and most acceptable. All methods of heating by friction are delusions, and air has not capacity enough for heat to be used successfully as a means of conveying heat, unless very large apparatus can be cheaply produced to heat a very large volume of air. It would be hard to conceive a purpose for which heating by friction would be preferable to heating by direct radiation or contact. Burned in a fur-



MACKENZIE'S TIRE INDICATOR.

Many master mechanics are becoming impressed with the opinion that the most effectual way to restrain the wear of locomotive tires is to keep an accurate periodical record of the wear of all tires, and hold the men running the engines responsible when there are evidences of rapid wear being caused by mismanagement. The first move toward doing this systematically was the production of a convenient gauge indicator, and Mr. John Mackenzie, of the New York, Chicago & St. Louis Railway, appears to have supplied the want when he invented the arrangement shown in the cuts. The directions for using the tire indicator are as follows: Place the card in indicator so that the bottom of the card is on the line *b b* marked on the indicator plate. See that the pencil point is at *O* on card when the pencil is at its lowest point. Place the instrument over the tire, with centers *c c* at joint of tire and wheel center. Pass the pencil-holder across the face of the tire. The wear of the tire will be indicated by the horizontal lines in $\frac{1}{16}$ths; the thickness of tire by the vertical scale.

Heating Air by Friction for Car Heating.

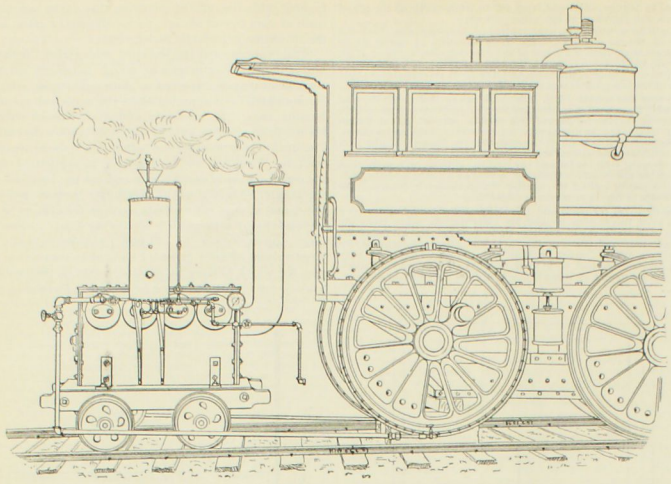
The fertility of American inventive genius is always well illustrated when railroad appliances call for improvement. Car couplers, impact brakes, wheels that move on the axles, oil boxes, lubricators, injectors, safety valves and a great many other parts of railroad machinery have all had their day of devotion when the inventive army of the country appeared to be bowing to that particular shrine. The fashion has again changed, and the leading object of inventive devotion is at present the heating of cars. Many curious sacrifices are likely to be offered on this shrine. One of the latest inventions is described as consisting of forcing air into a cylinder and retaining it there under pressure while it is being subjected to the action of rapidly moving frictional appliances by which it becomes heated to any desired degree and allowed to escape at any temperature into storage tanks. This is accomplished by the use of a thermostatic valve which is gauged to the required heat and acts automatically, so that there is a constant supply of compressed air entering the tanks, from which it is conveyed by pipes through the cars to be warmed. The paper describing the invention adds that it was produced by a woman, that it embraces generic principles and forms the basis of a foundation patent, all of which will, no doubt, excite awe and wonder in the minds of the railroad men destined to be

nace, one pound of good coal contains about 14,000 heat units, 50 per cent. of which can be transferred direct to water or air for heating purposes. If this heat is to be conveyed by mechanical means to the water or air to be used for heating purposes, steam is raised in a boiler, passed into a cylinder to drive an engine and the engine drives the heat producing apparatus. In this cycle about 5 per cent. of the heat energy of the 14,000 heat units is utilized in the engine, and it will be a good friction apparatus that will convert half of the power transmitted into heat. At this rate the roundabout process of making heat will, under favorable circumstances, return about 2½ per cent. of the heat generated in the original combustion, or 350 out of 14,000 heat units will be available for passing through the pipes to heat the cars.

Air is so easily heated compared with water that many people are deceived respecting its capacity as a means of conveying heat. The inverse fact is lost sight of, that being easily heated, air is easily cooled. One pound of water occupies 27¼ cubic inches, and one pound of air at the pressure of the atmosphere occupies 22,464 cubic inches. The heat needed to raise the temperature of the water one degree will raise the temperature of the pound of air nearly four degrees, so that the large volume in one pound of air will not give off more than ¼ of the heat that the small body of water will part with. These are facts that parties intending to heat cars by air would do well to ponder over.

Mr. H. D. Gordon, master mechanic of the Philadelphia, Wilmington & Baltimore Road, has charge of a locomotive, No. 317, an ordinary eight-wheel engine, which ran 17,112 miles in passenger service during the month of May. This was double service, but it was the greatest mileage for one engine that we remember seeing recorded. If any of our readers know of any thing authentic that will approach or surpass this as the monthly mileage of one engine, we would like to hear from them. It was as great a mileage as some engines make between periods of shop repairs, yet the engine was said to require very little running repairs. It appears to be a good object lesson in favor of keeping locomotives constantly on the road till they are worn out. Mr. Gordon has 13 engines that do half the mileage done by No. 317 right along every month, making something like 100,000 miles annually, which is pretty good mileage. One of these engines lately pulled a passenger train of nine cars 138 miles in 2 hours and 47 minutes, and made two stops.

* These men are regular coal-heavers, and only do the work of signaling when the foreman is busy checking up time or taking numbers of cars. One is employed at night and one in the daytime.



APPARATUS FOR HEATING, SETTING AND REMOVING TIRES.

The apparatus shown in the engraving is patented by Mr. W. Gentry, master mechanic, and Mr. George W. O'Brien, general foreman, of the shops of the Richmond & Danville road. Its use upon this road has been very satisfactory, saving fuel, time and labor. Mr. Gentry has found by experience that the kerosene oil burned in removing and replacing six tires will not cost more than one dollar.

There is a generator in which are four retorts, which are heated by coke, coal or wood. Into one of these retorts oil is fed through a very small opening and needle-point valve. This generates gas, which passes into another retort. The two other retorts are for heating the air that is used with the gas. In close proximity is a tank containing about ten gallons of common kerosene oil, and at any desired place is an air compressor that supplies air to the device. A very convenient arrangement is an air brake pump. Attachments are made to this oil tank, on top, so that an equal air pressure is on the oil that is operating on any part of the plant. This is controlled by a valve at the will of the operator. A larger connection is made with the two air retorts in the generator, so that the air and gas are about the same temperature and are propelled by the same force through the generator.

A pipe encircles the tire, perforated at intervals of 2½ inches with small holes. This pipe is cut and plugged so that it can be put on the wheel without taking down the connections. It is held off the tire about an inch by studs. From the generator to the burning hoop is made a connection, through which the gas flows, and in a fitting with an injector nozzle the air mingles with the gas and forces both through the burning hoop that has been placed around the wheel. After the furnace has been fired up and the retorts are hot, air is admitted to them; also, the oil through the needle point valve, and in a few seconds gas can be admitted into the burning hoop and fired. The amount of flame is regulated by the needle-point valve. The gas is made only as fast as used, and is under absolute control. There is no waste and no danger. The points of pressure all have gauges and can be seen by the operator. The flame that strikes the tire is a blue one and intensely hot, penetrating the tire very quickly. By placing the generator out of doors, along a wall or any convenient place, no more danger need be apprehended than from an ordinary stove. The oil tank, manipulating valves, gauges, etc., are inside, close by the track that the engine is run in on.

Arrangements have been made with Messrs. Pedrick & Ayer, proprietors of L. B. Flanders' Machine Works, Philadelphia, Pa., for the manufacture and sale of the apparatus.

Different Dimensions of Christie Brake Shoes.

The members of the Master Car-Builders' Association have sometimes displayed surprising reluctance about adopting standards, but when standards have been once agreed upon, it is an exceedingly difficult matter to effect any change or modification even in forms and dimensions that are evidently unsatisfactory. This is right and proper, for a change of standard is certain to produce great inconvenience and expense to the roads that have shown an inclination to adopt the standards agreed upon by the association. But the opposition to making changes, and the inconveniences that would arise from altering established forms, ought to make the officers of the association exceedingly careful to see that the forms and dimensions recommended for adoption are the best adapted to the wants of railroad companies.

Our generalizing in this strain is suggested by the movement made in the Minneapolis convention to change the dimensions of the Christie brake shoe head that had been adopted by letter-ballot. This shoe and head has for years been in use by many roads, and the fact that it was already largely in use had weighty influence in getting the forms adopted as the standard brake shoe and head of the association. It is well known that there is very great difficulty in getting different roads to hold close enough to established standards to keep them interchangeable, and that being the case, it was a foregone conclusion that different roads using for years a form of brake shoe like the Christie, but not a standard, would fall into diverse sizes. It seemed then a plain and obvious duty on the part of the officers of the Master Car-Builders' Association to ascertain the dimensions of the Christie shoe and head most generally used and recommended that for adoption. Instead of doing that, the responsible officer found out the dimensions of the Christie shoe and head in use on the Boston & Albany road, and recommended them as the standard of the association, and they were adopted without the members generally being aware that the Boston & Albany Christie head was two inches longer between the outside of the bearings than the heads used on most other roads. The discovery of this fact became generally known only when manufacturers were invited to supply the standard shoe to roads already supposed to be using it. This is a very bad muddle, and is likely to greatly neutralize the advantages to railroad companies of the adoption of a standard brake head and shoe. There are said to be over 60,000 cars equipped with various dimensions of the old Christie shoe, and only about 6,000 of them will interchange with the standard shoe. The roads which have been using the old Christie shoe no doubt voted for its adoption as a standard on the understanding that they had to make no change. They no doubt found the dimensions used to be perfectly satisfactory, and it is unreasonable now to urge them to change their patterns to fit a standard begotten in ignorance.

Perfected Westinghouse Brake.

When the brake trials at Burlington in May last appeared to indicate that electricity was necessary to operate brakes to prevent shocks in emergency stops, Mr. George Westinghouse Jr., insisted that improvements could be effected that would enable air alone to perform all that was wanted. He proceeded to Pittsburgh and went to work perfecting his apparatus. The perfected apparatus, simple in every particular, was as promptly as possible applied to the test train, and on June 24 a public test was made at Burlington with a train of 45 cars, Mr. G. W. Rhodes, the able superintendent of motive power of the Chicago, Burlington & Quincy, and other prominent railroad men being present. A full run over the ground was made with the following results:

Stop.	Speed.	Feet.	Time.	Shock.
1	19¾	155	8⅛	6¼ inches.
2	34½	420	14⅜	6¾ "
3	21	175	9¼	¼ "
4	36½	480	18⅛	5 "

Our readers will remember that the maximum shock considered admissible for stock trains was 12 inches. In the tests mentioned the stops are extraordinarily sudden, yet the greatest shock was 6¾ inches movement of the slidometer, and it really was not a shock but a surge. We can not see or imagine any thing more perfect than that being desired. The brakes are thrown on full without the least warning, and the train stops as suddenly as a train does in most collisions; yet it comes to rest without a shock that would do damage to the most fragile goods, or cause the least discomfort to passengers.

For the last six months the Niles Tool Works have been working 23 hours a day. The demand for tools that causes the works to be operated day and night comes largely from railroad companies.

Communications.

Steam from Hot Water.

Editors National Car and Locomotive Builder:

It is well known that if a closed vessel be partly filled with water, the space above the water will become filled with the vapor of the water, and the elastic force of this vapor will depend upon the temperature of the water. If the space above the water be enlarged, or the external pressure which confines the vapor be diminished, the water will give out additional vapor and the temperature of the water will be reduced.

In the admirable articles on "Steam and Motive Power," which appear in your current issues, a tube of one square foot cross sectional area is supposed to contain one pound of water under a piston with an absolute load of 145 pounds to the square inch. Such a load renders it possible to heat the water to 356 degrees, or 144 degrees above the boiling point at atmospheric pressure before boiling will begin.

Now the questions arise:

First—What would be the result if, when the temperature of the water had reached 356 degrees, and before boiling began, the load on the piston be instantly removed?

Second—What would be the result if, with the water at 356 degrees, the source of heat be removed and the load on the piston be gradually decreased, supposing no heat lost by radiation?

The answer to the first question is, that the piston would go out of the tube like a ball from a cannon; and to the second question, that the piston would gradually rise and be followed up by steam of a tension corresponding to the decreased load, until the temperature of the water had fallen to 212 degrees, and the load on the piston had been reduced to atmospheric pressure.

The quantity of steam at atmosphere pressure that can be obtained from one pound of water at 356 degrees, and the height to which the piston will rise by having its load gradually reduced, would probably be estimated as follows:

At atmospheric pressure, 966 heat units will convert one pound of water at 212 degrees into 26.36 cubic feet, or 45,550 cubic inches of steam. Therefore, each heat unit makes $45,550 \div 966 = 47.16$ cubic inches of steam, and the 144 heat units in a pound of water at 356 degrees over and above the heat at which it gives off steam at atmospheric pressure will make $47.16 \times 144 = 6,791$ cubic inches of steam. The cross section at area of the tube being 144 square inches, the piston will be raised $6,791 \div 144 = 47$ inches, or 3.9167 feet.

One cubic inch of steam at 145 pounds per square inch absolute pressure, will make 8.6 cubic inches of steam at atmospheric pressure. Therefore it will require 790 cubic inches, or 0.15 of a pound, of steam at 145 pounds per square inch, to make 6.791 cubic inches of steam at 14.7 pounds per square inch. Hence in a locomotive boiler with an absolute pressure of 145 pounds per square inch, there is as much power in one pound, or 27.7 cubic inches, of water, as there is in 790 cubic inches of steam. Or one cubic inch of water will do as much work as 28.5 cubic inches of steam will do; 6.67 pounds, or 185 cubic inches, of water are equivalent to one pound of steam.

In expanding one pound of steam from 145 pounds to 36.25 pounds absolute pressures per square inch, the temperature falls from 356 degrees to 261 degrees, and ten per cent. of the heat expended in making the steam is utilized.

To obtain another pound of steam, one pound of water at 50 degrees must be evaporated by an expenditure of 1,172 heat units. Now, if the pound of steam had been drawn from 6.67 pounds of water at 356 degrees, after doing the same work, there would remain 5.67 pounds of water at 261 degrees, and to obtain another pound of steam, one pound of water must be heated from 50 to 356 degrees by an expenditure of 306 heat units, and 5.67 pounds of water must be reheated from 261 to 356 degrees by expending 533 heat units, or a total of 839 heat units; 111 heat units have been converted into work, so that the economical efficiency of work done is $\frac{111}{839} = .13$, or thirteen per cent.

This apparent gain of three per cent. arises from assuming that all of the steam is formed after the water has been heated to the boiling point, and that a pound of steam has been drawn from the water by the pressure being decreased to 36.25 pounds per square inch.

As to the first assumption, it is more probable that each one of the 1,190.4 heat units required to evaporate a pound of water under an absolute pressure of 145 pounds per square inch, makes the same quantity of steam, or 38 cubic inches of steam at atmospheric pressure. This would make 8.3 pounds of water at 356 degrees, equal to one pound of steam at 145 pounds absolute, and reduce the economical efficiency to 11 per cent.

As to the second assumption it can probably to determined only by experiments what quantity of steam a volume of water at 356 degrees, capable of furnishing 45,550 cubic inches of steam at atmospheric pressure, would furnish at 36.25 pounds absolute pressure. It may, in strict conformity with the dynamic theory of heat, be accepted as a fact that the economical efficiency of the work done

is the same, whether the steam be drawn from water taken from the boiler, or whether it be taken from above the water in the boiler.

There may be, however, a decided advantage and economy in drawing hot water instead of steam from the boilers that supply our engines, especially our locomotives.

It is well known that in cutting off with the link motion, the attainable economy from expansion is far from being realized. How such an economy may be closely approximated by using hot water instead of steam will now be considered.

Suppose the steam chest cover to be made hollow, and forming a box, say 20×19 inches, and one or two inches deep, this box to have openings in its upper part, communicating with the interior of the steam chest, and to be provided with an outlet pipe leading to a pump which discharges into the boiler. Suppose, also, a tube extending from the crown sheet of the fire-box to the box above described, say through one of the boiler flues, and provided at the end next to the steam chest with a valve, by means of which any desired quantity of water may be let into the box. Suppose now, the boiler pressure being 145 pounds to the square inch, absolute pressure, and the cylinder having a capacity of one pound of steam at that pressure, it is desired to use a quarter of a cylinderful of steam, or to cut off at quarter stroke, then, instead of changing the travel of the slide valve, two pounds of water will be let into the box, forming a layer about one-eighth of an inch thick.

This water will give out steam enough to fill the cylinder with initial and final absolute pressures of 145 and 30 pounds per square inch, respectively. The temperature of the water will fall 106 degrees, or to 250 degrees, at which temperature it will be pumped back into the boiler.

A very important gain, due to this method of distributing steam, arises from the lesser amount of condensation during expansion. When steam is cut off from communication with the boiler and allowed to expand, a much greater condensation ensues than can be accounted for by the work done and the difference in temperatures of the initial steam and the metal with which it comes in contact.

This extra condensation is attributed by different authorities to various causes, but, be the cause what it may, to it is mainly due the difference in weight of the steam shown by the indicator and the weight of the water evaporated in the boiler. When the steam is kept in communication with the water and drawn expansively from it as above described, no such condensation will occur, because the heat demanded by this unascertained cause will be drawn from the water and not from the steam itself, as is the case when communication with the boiler is shut off.

By drawing the hot water from the fire box end of the boiler, and returning the waste water to the smoke-box end, a positive circulation is insured, thereby lessening any tendency to overheating and increasing the efficiency of the heating surface.

The desired quantity of hot water may be delivered in a constant stream, and an independent pump would be required to return the waste water to the boiler at an expense of about one per cent. of the power developed.

The method of using hot water above described must not be confounded with the attempts made by Jacob Perkins some sixty odd years ago. The non-success of his plans arose from heating the water in strong metallic vessels completely filled, and it can readily be understood that water so heated may exert an enormous pressure on an inelastic envelope and still be incapable of doing any work. For instance, water at 39 degrees completely filling a vessel, would, when heated to 212 degrees, exert a strain of several hundred atmospheres per square inch, and still be incapable of doing any work against a pressure of one atmosphere, or 14.7 pounds per square inch.

A hot water locomotive would be, in a measure, an automatic cut-off engine, for the reason that a stream of water sufficient to supply a cylinderful of steam at a slow speed would supply practically only a quarter of a cylinderful at four times that speed. G. B. MAYNADIER.

9 PLYMPTON STREET, CAMBRIDGE, MASS.

Comparison of Locomotives.

Editors National Car and Locomotive Builder:

As the May number of your journal contained a reply to my communication in your April issue, headed "Locomotives Compared," I feel justified in trying to substantiate what I said in favor of the engine "Delano," No. 66, of the Lehigh Valley road.

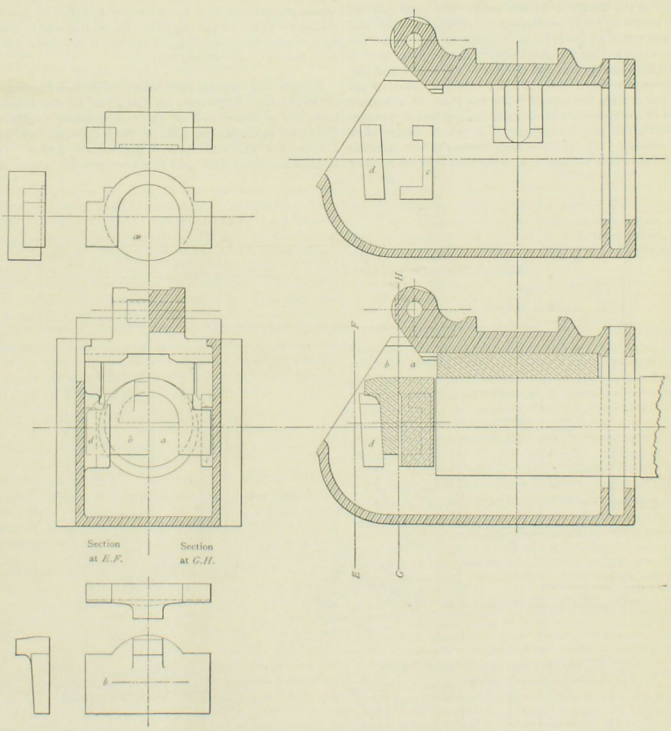
Your correspondent, "Miller," says in his reply that the engine "J. W. Miller," recently built at the Rhode Island Locomotive Works, has about 1,000 pounds more tractive power than the "Delano." I fail to figure in that way, but admit she has a few hundred pounds more. You will observe that in your April number I claimed that boiler pressure at 135 pounds to the square inch was the most satisfactory to us, but "Miller" only gives me credit for 130 pounds. He says that "it is steam, not weight, that enables an engine to pull a train." Now, suppose you have the 180 pounds pressure (claimed for the "J. W. Miller") and an engine weighing from 25 to 30 tons, does he expect to pull the same train in the same time that the "Miller" engine would pull it? And if so, what is the use in building an engine to weigh 96,000 pounds? Your correspondent also says that "the efficiency of a fast passenger locomotive depends very much on how the train is got away from a stopping point."

The following are the particulars of one of the usual runs made by the "Delano:" From Mahanoy City to Delano is exactly 5 miles. The grade for 2¼ miles is 150 feet per mile, and the remaining 2¾ miles vary from 150 to 79 feet per mile. There are five starts, five stops, and one slow-up. With 4 heavy coaches, the run is made 12¼ minutes. This is sufficient proof that the advantages which the "Delano" has, come in at the right place. The difference in piston velocity is comparatively small, and the losses from friction and condensation are so slight that no account need be taken of them. This is the difference between the two engines.

The "J. W. Miller," your correspondent says, has sufficient weight to keep her down with 180 pounds pressure, and he admits that the "Delano" is heavier, yet we have trouble in keeping her down with 135 pounds pressure. This must surely prove "No. 66" works very easy. I saw an account of the "J. W. Miller" in which it was stated that it took three tons of coal to get the fire in proper condition for starting. We use on the "Delano" only half a ton to have the fire in first-class condition for starting. The run is 156 miles per day, or 936 miles per week, consuming about 15 tons of coal per week. In returning this 156 miles per day there are 52 stops, and no part of the road, except four miles, is level, the rest varying from level to 165 feet grade per mile.

I hope to hear from your correspondent in your next issue, and that he will give his real name. I hear from the East quite often and am somewhat aquainted there. I hope to send you indicator cards of engine "No. 66" in time for your next issue. W. J. MCCARROLL.

DELANO, Pa., May, 1887.



JOHANN'S END-STOP AND JOURNAL.

THE idea of an end-stop in journal boxes to take up the lateral thrust of the axle is not new, the appliance having been used as early as 1860, but inasmuch as no provision was made to prevent the end stop from working upwards and outwards, it was in this respect defective. In the arrangements shown in the cuts, this defect is entirely overcome and the end-stop secured against any movement in any direction, by means of lugs cast on the sides of the box, and a taper key.

In the cuts, *a* represents the end-stop, which may be made of cast-iron with chilled face, or of brass; the key *b* fits between the inclined lug *d*, cast on the box, and the stop *a*, forcing the stop firmly to its place in the lug *c*, also cast on the box. A single journal brass replaces the M. C. B. brass and wedge. The only difference between this arrangement and the M. C. B. standard journal box and axle, is in the lugs cast on the sides of the box, and in the ends of the axle not being swedged down for the journal.

The M. C. B. axle, brass and wedge can be used in connection with the end-stop and key, so that if a car having this journal should require to have any of the parts replaced, when on a foreign road not carrying these axles and brasses in stock, the M. C. B. standards will not be interfered with.

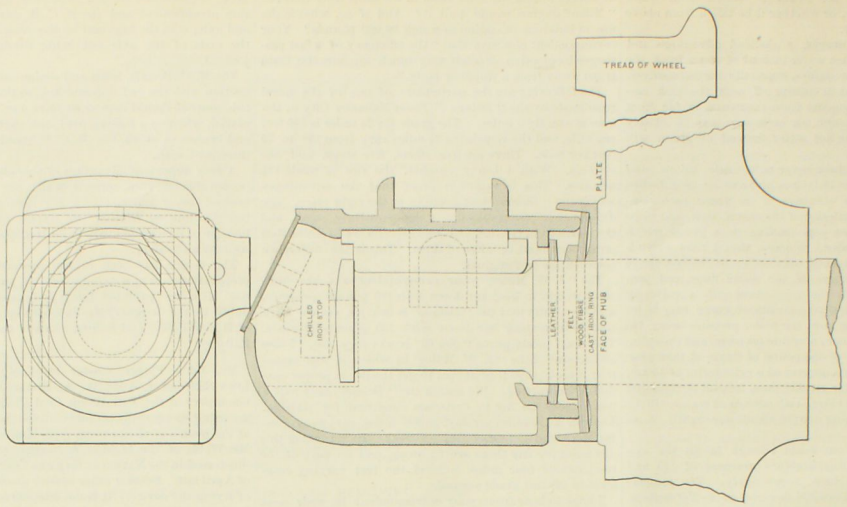
A very important advantage of this plan, aside from the immovable end-stop, consists in the use of a largely increased size of journal (4½″ × 8″) thus greatly diminishing the journal friction per square inch, and enabling heavier or overloaded cars to be transported with greater security and safety.

The device has been in use upwards of a year, and preparations are now being made to put it into general use. It is not patented, but is dedicated to the railroad public by the designer, Mr. Jacob Johann, Superintendent of Motive Power and Rolling Stock of the Texas & Pacific Railway.

Mr. John Player, master mechanic of the Central Iowa Railroad, and Mr. W. A. Foster, superintendent of machinery of the Fall Brook Coal Companies' railways, are using successfully on locomotives the double cone set at the mouth of the exhaust pipe, similar to that used by Mr. Webb, of the London & Northwestern Railway, and illustrated in the NATIONAL CAR AND LOCOMOTIVE BUILDER, of April last. Several other master mechanics are talking of trying the device. It is not adapted for any but engines having a high single nozzle, but with such engines the "torpedo," as they call it in England, may be the means of making engines steam with an enlarged exhaust nozzle.

Mr. William Wilson, master mechanic of the Chicago, Alton & St. Louis Railroad, has recently built a new mogul engine and equipped it with his radial gear. Blue prints of the engine and diagrams taken when the engine was pulling a train of sixty loaded cars were exhibited at the Master Car-Builders' Convention and excited much interest among the members and visitors.

While in St. Paul lately we examined some Randolph metallic bearings for engine trucks, which were removed from an engine belonging to the Northern Pacific Railroad after having run 166,418 miles. The bearings, which are made of a white metal, were still in good order, the reduction of weight for the mileage mentioned having been only about 4 ounces.

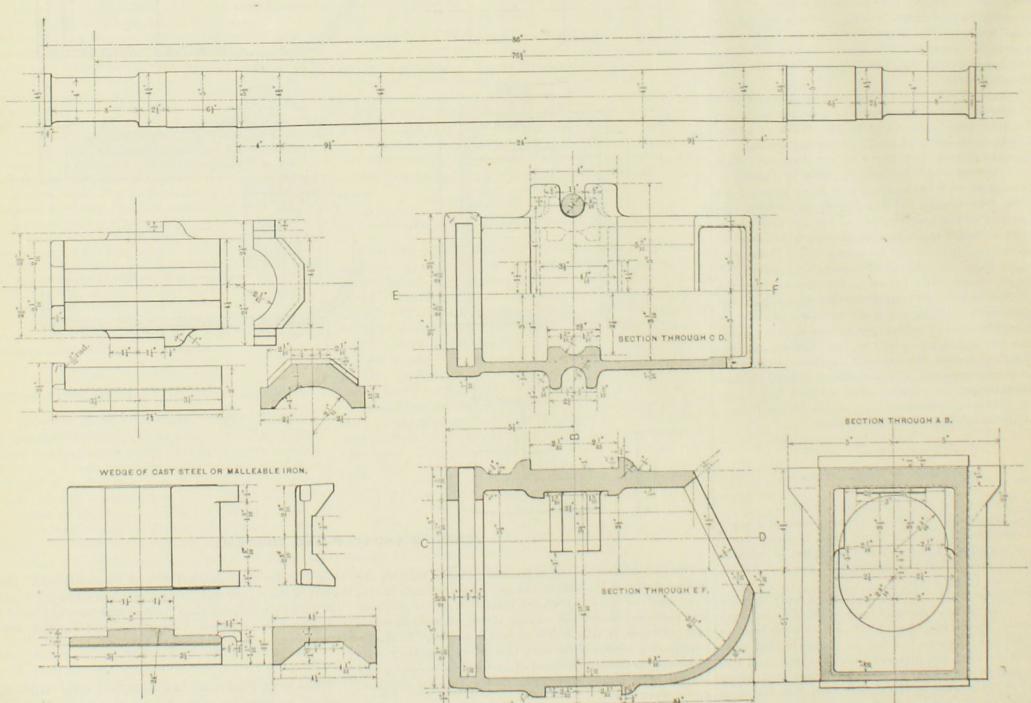


ADAMS' DUST-EXCLUDING OIL BOX.

The above cut illustrates a new style of oil-box recently designed by Mr. F. D. Adams, general master car-builder of the Boston & Albany road. The principal objects sought in the improvement is to keep out dust and grit and retain all the lubricants inside of the box. The box is made so that an attachment to it is a ring that is placed between the box and the hub of the wheel, and carries rings of felt and of wood fiber. On the inside of the box, and coming in contact with the ring, is a leather guard of the style used in old-fashioned oil boxes. Leather is used for this purpose because it is got in easier than fiber or wood. The movable ring between the box and the hub is made with a collar, which projects over the neck of the box and acts as a dirt shield. The neck of the box is kept up to the movable ring by the brass and wedge, and undue pressure on these is relieved by a chilled iron stop, which fits to the end of the axle. The stop is held in place by recesses cast in the box. Application has been made for a patent on the arrangement.

A paper was recently read before the British Institution of Mechanical Engineers, on Canadian Pacific locomotives, and a description of the consolidation engine we illustrated in the May number of the NATIONAL CAR AND LOCOMOTIVE BUILDER formed part of the paper. The English engineers talk just as contemptuously about the Canadian locomotives as they habitually do about those constructed by railroad and contract shops in the United States. A press of matter this month prevents us from dealing with the paper, and the discussion thereon, as we would like to do, but we will have more to say about them at another time.

The Burlington, Cedar Rapids & Northern Railway Company are doing a great deal of work this season improving their main line. A great many pile bridges and trestles are being replaced by stone culverts. In one place they are cutting down the hill at the top of a heavy grade and filling in at the bottom, at an expense of $35,000.



AXLE AND JOURNAL BOX FOR CARS OF 60,000 POUNDS CAPACITY.

(See Report of Committee, Page 90.)

NATIONAL CAR AND LOCOMOTIVE BUILDER

PUBLISHED MONTHLY
BY
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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock, construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

The Master Mechanics' Convention.

The famous twin cities of St. Paul and Minneapolis are so far away from the centers of railroad population, that it seemed an experiment of questionable wisdom to hold the annual conventions of Master Mechanics and of Master Car-Builders in cities that could be reached by most of the members only after long, tedious journeys in a hot, dusty season of the year. It indicated laudable zeal on the part of the members to find an excellent attendance at both conventions, and it was particularly creditable to the members of the Master Mechanics' Association to find that the largest attendance ever present at any of their conventions assembled at St. Paul. All sections of the country were well represented, and the South was conspicuous for the number of members present from that portion of the country and for the ability of the representatives. The convention was notable in several respects. President Johann held the meetings closely to the order of business. There was very little disposition manifested to waste time by wrangling or trifling talk; the reports were excellent, and away above the average in the information elicited and in their literary make-up. The discussions were lively, valuable and interesting, and an excellent spirit of give and take pervaded the meetings. Another point that deserves special notice, and for which the members ought to be highly commended, was the attendance during the sessions. Counting the new members, there were about 100 in the hall when the roll was called on the first day, and nearly the entire number was present throughout the whole of each meeting. The reading of the longest reports and the transaction of uninteresting routine business made remarkably little difference in the attendance, most of the members listening patiently to all that was said or done. This was just as it should be, but it was in pleasant contrast to what is generally seen at conventions and meetings of similar deliberative bodies. It seemed to us too, that the effect of the frequent meetings of railroad clubs which many of the members have attended during the past year, was apparent by the increased fluency of the speakers.

The hold which the late President Woodcock had upon the hearts of the members was apparent in the many expressions of regret that were heard on all sides as soon as the members began to arrive, and the numerous incidents related to illustrate the genial, pleasant ways of the man. The Association passed eloquent resolutions of regret at the loss of the President, but the warmest and most heartfelt tributes were expressed privately among members as they talked together of the man they had lost. These were far more eloquent and freely delivered than the eulogies that followed the introduction of the formal resolution.

The short discussions of topical subjects that were taken up at each noon hour proved highly successful, as they have always been since first introduced. The discussion that arose the first day on Extension Smoke Boxes was, indeed, the most lively debate of the convention, and roused the members so thoroughly that its influence appeared to be felt throughout the whole of the remaining sessions. Considerable feeling was manifested between the advocates and opponents of the extension front, and it was surprising that such diverse views were held by equally able men on a subject which ought to admit of little difference of opinion. Carefully conducted experiments by competent experts would, we think, shed valuable light on the relative merits of the various spark arresters in use, and the results might be valuable to members who are halting between two opinions.

The first report read treated on Proportion of Locomotive Cylinders, and it was one of the best ever submitted to the Association. The subject is of the very greatest importance to railroad interests, and Mr. Charles Blackwell evidently appreciated the case at its proper value, for he must have devoted arduous and studious labor to the preparation of the report. We will have more to say about this report and its teaching in future issues.

The report on Traction Increasers was the weakest submitted to the convention. The information given was althgether in too diffuse a form and contained too many opinions of members who had no experience with devices of the kind. The discussion which followed the reading of the report indicated that the traction increaser had many opponents, but that it had also not a few friends and advocates. Both sides were very pronounced in their views, and on the whole it looked as if this means of increasing the adhesion of locomotives had more friends now than it had a year ago, although the men who have had actual experience with traction increasers were few and far between. The subject will be further investigated, and reported upon next year, and it is hoped that the committee will be able to tell something more definite about the effect of traction increasers in actual service than was given this year.

The subjects of Piston Packing and Stuffing Box Packing were combined in one report and treated separately, exhaustively and well. The conclusions were, that cast-iron rings held out by their own spring were the kind of piston packing in most common and successful use, and that various types of metallic packing are making rapid progress in popular favor.

We will say nothing more at this time about the other reports, as we intend commenting upon each separately when time permits.

About the time the convention met the report was circulated that Secretary Setchel would not accept another election to the position he has held so long, and filled with such eminent satisfaction to all connected with the association. The members, with one accord, decided that it would be a fitting tribute to Mr. Setchel to elect him president; but on the other hand, all agreed that Mr. Johann, who has always been known as one of the hardest working members of the association, must not be passed over. When the time for the selection of officers came round, the nominating committee recommended Mr. Johann for president, and that gentleman, with great magnanimity, resigned in favor of Mr. Setchel. There are few men capable of performing the personal sacrifice that was quietly done by Mr. Johann on this occasion. The election of the new officers passed off with the greatest of good feeling. The selection of Mr. John Mackenzie to be second vice-president was a good one, for he is one of the ablest young men in the organization, a bright, brainy man, with progressive opinions and ideas of his own, and ability to express them. Of the election of Angus Sinclair, one of the editors of this journal, to succeed Mr. Setchel as Secretary of the Association, we will say nothing, except that the honor was unsought, and that the election was unanimous.

The Car-Builders' Convention.

The elaborate reports made by the respective committees on freight train brakes and automatic couplers, so different in their tenor from the previous reports on the same subjects, are likely to be conspicuous landmarks in the history of the association. Something has now been done in the line of progress that will not have to be done over again. The Burlington tests have shown that the brake and coupler problems run together to such an extent that neither of them can be completely solved independently of the other. So much new light has of late been thrown upon both, that the dilatory action in the past is not so much to be regretted; and the law-makers of the land will be less hasty in passing compulsory enactments under the stimulus of current estimates of the number of trainmen killed and injured. The brake committee have only to continue the work they have thus far done so thoroughly, in order to secure practical results that will be final and conclusive.

The report of the executive committee on the coupler question was quite a surprise. Its conclusions and recommendations are almost startling in their definiteness as compared with the tameness and indecision of the committee's report last year. Instead of practically ignoring the coupler question and directing attention to draw-heads and dead-blocks, it now squarely recommends for adoption by the association as a standard, a form of coupling of the Janney type, this type including all other forms that automatically couple to or with the Janney coupler under all conditions of service. The committee says that "slack" is an "enormous evil," and that its value in couplings has been "decided." Nothing is said about abandoning link and pin couplers, but the inference is obvious. The Janney, or vertical type may not be the best. Many railroad men who are wedded to the link and pin and believe in slack, think it is not. But the committee, evidently under the pressure of emergency, was forced to act on the theory that the choice of a *type*, even if it be not absolutely the best, is better than to let the thing drift when the breakers are so near. The convention seemed to take the same view of it, and sent the recommendations to letter-ballot.

This tribunal of last resort is practically a very good thing. Like the "previous question" in parliamentary practice, it chokes off debate and forces a vote on the main question. Of the 17 proposed standards submitted to the L. b. ordeal since the reorganization of the association in 1882, ten have been adopted. This does not include the four new propositions sent to the ballot last month and not yet voted upon, namely, the Michigan Southern Draw-Gear for Non-Automatic Couplers; Parts of Freight Car Truck for Cars of 60,000 pounds capacity; Sizes of Lumber for Freight Cars; and Janney type of coupler. At the risk of traveling a little out of the record, we would suggest, parenthetically, that one of these days somebody may propose an L. b. ordeal for "extension fronts."

No reports were made by the Committees on British and Continental Practice; Platform Timbers for Freight Cars Maximum Outside Dimensions of Freight Cars; and we have heard of no report on Appliances to Prevent Slipping of Wheels. In regard to the three first-named topics, no reports were expected, for obvious reasons, which we need not recite.

The convention next year will be held at Alexandria Bay, N. Y. The master mechanics will also meet next year at the same place.

Mr. R. C. Blackall has for years been regarded as one of the hardest working members of the Executive Committee of the Master Car-Builders' Association, and no one belonging to the association has displayed a warmer interest in its affairs or labored more diligently in promoting its interests. In view of these well known and generally recognized facts, it was a genuine surprise to most of the members when the committee on nominations proposed leaving Mr. Blackall out of the Executive Committee and substituting the name of Joseph Woods, of the Pennsylvania Railroad. There seemed to be no intelligible reason for the change, and the rank and file of the association would not have the change carried out. Before the time for electing the new officers arrived it appeared as if three-quarters of the members present had resolved themselves into a committee for the purpose of electing Mr. Blackall over any opposition that might be raised, and they carried out their purpose with considerable enthusiasm. Printed voting papers were prepared and circulated, and when the announcement was made that Mr. Blackall was elected, it was received with enthusiastic cheers that showed plainly how deeply stirred was the heart of the association.

Liquid Fuel.

If petroleum or other hydro-carbons could be applied successfully as fuel to locomotives, the traveling public would be greatly benefited through the absence of smoke and cinders. The principal obstacle encountered in the introduction of liquid fuel for locomotives has been the matter of cost, coal being much the cheaper combustible. There are circumstances where it would pay railroad companies to use dear fuel of the kind referred to, if the difference between it and coal was not very great. The annexed extract from an English journal tells of liquid fuel being quite successfully applied to steamers. Coal is cheaper in England than in America, and petroleum costs more there than it is sold for here. If the dear fuel can be employed economically for steamboat service there it ought not to be too expensive to burn in our locomotives.

"An important advance has just been made in utilizing hydro-carbons for steam raising purposes on board ships. A legitimate objection to the adoption of liquid fuel at sea under certain circumstances has been that the use of steam for the diffusion of the oil in the boiler furnaces entails a considerable loss of fresh water from the boilers. As this loss has to be made good by salt water on long ocean voyages, the density of the water is rapidly raised to a dangerous point. This is, however, entirely overcome by the system adopted in the steamship Charles Howard, owned by Messrs. Alfred Suart & Co., which has recenly been fitted with tanks for carrying refined petroleum in bulk, and also with Tarbutt's system of burning residual oils under the boilers instead of coal. She is 249 feet in length, with 30 feet beam, and 23 feet depth of hold. The whole of the cargo space in the vessel is occupied by tanks for carrying the refined petroleum, while the refuse oil to be used for fuel is carried in the water ballast tanks. Her boiler is of the ordinary marine type, with three flues of three feet six inches diameter each. These flues are fitted with a brick combustion chamber feeding the boiler along with that condensed from the main engines. The Charles Howard left for the Black Sea, and as she steamed down the river at full speed not a particle of smoke was visible from the funnel, the fires working admirably from the first start. It is stated that the owners propose to fit the remainder of the fleet with similar apparatus. The storage of the oil in the water ballast tanks has, we believe, never before been introduced in practice. It is an important feature, as it saves the ship-owner the heavy expenditure incidental to the fitting of tanks in the bunker spaces, and, combined with the substitution of air for steam, marks a decided departure in liquid fuel practice."

New Narrow Gauge Passenger Cars.

The equipment of the Boston, Revere Beach & Lynn road (narrow gauge) has recently been increased by the addition of five passenger cars and one combination baggage and smoking car, built by the Laconia (N. H.) Car Co. The passenger cars are 60 feet long and 9 feet wide over all, weigh 20 tons and seat 68 persons each. The inside finish is in solid mahogany, with the exception of the ceilings, which are maple and quartered oak. The cars are all furnished with Henry tilting seats upholstered in rattan by the Wakefield Rattan Co. The metallic trimmings are nickeline silver, and were manufactured by the Oneida Community (Limited), Niagara Falls. This material closely resembles silver in appearance, but being a solid, white metal, there is no plating to wear off, nor will it tarnish or change color. The floors are lined with mineral wool. The trucks run on 30-inch steel wheels, and by a peculiar arrangement of the springs the car bodies run very low. The first locomotives built for the road weighed only 17 tons each. Those recently built weigh 32 tons. The first passenger cars were 37 feet long, 8 feet wide and weighed only 8 tons each.

The List of Exhibits of Railway Appliances at the Master Car-Builders' and Master Mechanics' Conventions has been crowded out of our present issue. It will appear in our next.

THE present list of officers of the Brooks Locomotive Works is as follows: President, Edward Nichols; Vice-President and Treasurer, M. L. Hinman; Superintendent, J. H. Setchel; Secretary, T. M. Hequembourg; Agent, R. J. Gross. Mr. Nichols, the newly-elected president and successor of the late Mr. Brooks, is an engineer and graduate of the Troy Polytechnic, has first rate executive ability and large experience as an officer of various mechanical enterprises. The other officers have been connected with the works for many years, and are well known to railroad men.

THE Prospect Machine & Engine Co., of Cleveland, O., have made an assignment. The works, we are informed, will be started up by the assignee, who will be prepared to fill orders as usual, and that the company is expected to resume its regular operations in a very short time.

Four Scarritt car chairs were exhibited at the Master Mechanics' Convention at St. Paul, their sizes and patterns ranging from the luxurious chairs used by the Palace Car Companies to the less pretentious but exceedingly comfortable ones used in chair cars. Besides the Pullman Co., some 15 of the principal railroad systems of this country have adopted these chairs. They are manufactured by the Scarritt Furniture Co., at St. Louis, Mo.

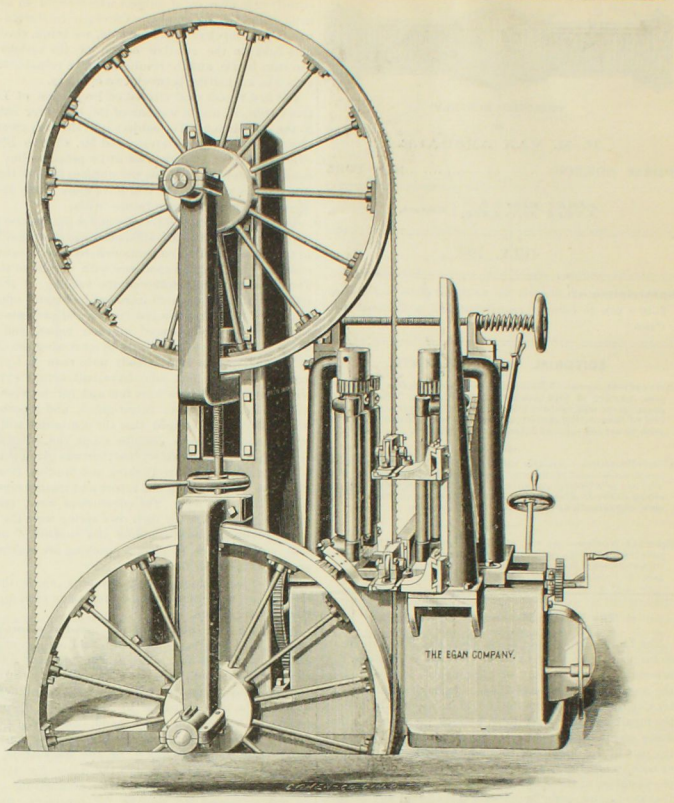
THE NATIONAL TUBE WORKS CO., of Boston, have issued a new catalogue containing descriptive illustrations of the Improved Mack Injector. The merits of the different classes of this device are set forth, accompanied with information in respect to their application, sizes, prices, etc., that will be found valuable by superintendents of motive power and master mechanics. The catalogue also contains descriptions of the company's brands of boiler tubes, with tabulated sizes and gauges.

THE marketing of the manufactured products of the Indurated Fiber Co., of Lockport, N. Y., as well as the entire output of the several manufacturers of indurated fiber goods, will hereafter be done by the Union Indurated Fiber Co., 110 Chambers street, New York, this arrangement having been deemed necessary to maintain card rates by dealers, and secure to both dealers and manufacturers the profit to which they are entitled. This company also has an office and salesroom at 73 Randolph street, Chicago.

MERCHANT & CO., of Philadelphia, have issued a pamphlet containing information about the manufacture, methods of laying on, and relative values of Roofing Plates. The plates of the "Gilbertson's Old Method" imported by this firm, are the only ones that have no waster or imperfect sheets. The firm has established agencies at San Francisco, San Diego, Portland, Ore., Omaha, Kansas City, St. Louis, Memphis, Cincinnati, Louisville, Indianapolis, Detroit, Buffalo, Pittsburgh and Boston, each of which carry full stocks of "Gilbertson's Old Method" and "Camaret" Roofing Plates.

"*A Summer Jaunt.*" "*Famous Resorts of the Northwest.*" Each succeeding year, after the first bright freshness of the spring foliage has disappeared to give place to the dust and dryness of the fierce June sunshine, when the gentle showers of early summer have been superseded by the sprinkling-cart and garden hose and the spring overcoat discarded for the linen duster, when the business man begins to hug the shady side of the street on his daily trips to and from his office, a very large proportion of the people of our great cities turn their thoughts toward the country and commence laying plans for the annual summer vacation, which, in these days of rapid money-getting and high-pressure living, has become an indispensable element in the calendar of every man of wealth and woman of fashion whose line of life has been cast in the seething, bubbling, tumultuous swim of modern metropolitan existence.

Address James Barker, General Passenger and Ticket Agent Wisconsin Central Line, Milwaukee, Wis. (mentioning this paper), for a copy of "A Summer Jaunt" and "Famous Resorts of the Northwest," two exquisite books on summer resorts, the former written by a well-known literary light, the latter compiled with accuracy and care, giving valuable information to the tourist.



NEW NO. 5½ BAND RE-SAWING MACHINE.

(*6 Feed Rolls, and Patent Top Tension.*)

The machine shown in the engraving is designed for use in large mills, car works, furniture factories, etc., where a great deal of resawing is done.

The wheels are 60 inches diameter, with extra large hubs and spokes and built up rims, perfectly balanced, with very large steel mandrels running in self-oiling boxes, and so connected to the mandrels as to make it impossible for them to get loose and run out of true. Each wheel is supported by an outside bearing on each side of the column, there being three bearings to both upper and lower shafts.

The feed is very powerful, consisting of 6 large feed rolls heavily geared, driven by a patent graduating feed, enabling the operator to change the speed instantly, by turning a hand wheel while the board is being fed through the machine. A ratchet lever handy to the operator is connected to the upper guide, made so as to change the guide instantly to suit the width of board to be cut, and hold the saw blade steady in the cut.

By an improved system of gearing—having the two front feed-rolls close to the saw blade, and an ingenious device connecting the top of roller brackets—the plank is straightened while being sawed, making a great saving in time and material. The patent guides are arranged so as to support the blade when crowded too fast.

Manufactured by the Egan Company, Cincinnati, O., who will answer inquiries and furnish their illustrated catalogue on application.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any errors that may be noticed in our list:

Atchison, Topeka & Santa Fe.—Geo. L. Sands has been appointed General Superintendent, vice D. J. Chase, resigned.

Atlantic & Pacific.—J. H. Scott has been appointed Superintendent, vice G. L. Sands, resigned.

Boston, Hoosac Tunnel & Western.—This road is now controlled by the Fitchburg Co. C. A. Coombs has retired from the position of General Manager.

Boston & Lowell.—The Passumpsic Division (formerly Connecticut & Passumpsic Rivers Road) is now under the authority of the general officers of the Boston & Lowell.

Chicago, Milwaukee & St. Paul.—E. W. McKenna has been appointed Superintendent of Prairie du Chien and Northern Divisions, vice Sumner Collins, who is now Superintendent of Kansas City Division.

Chicago, Rock Island & Pacific.—Geo. L. Chatfield has been appointed Assistant General Master Mechanic.

Chicago & Indiana Coal.—A. A. Hobart, heretofore Superintendent of this road, is now Superintendent of the Eastern and Northern Divisions of the Chicago, St. Paul, Minneapolis & Omaha.

Chicago & Northwestern.—Marvin Hughitt has been elected President of this company.

Chicago & Western Indiana and Chicago Belt.—P. H. Peck has been appointed Master Mechanic, vice R. W. Johnson resigned.

Chicago, St. Paul & Kansas City.—R. Du Puy has been appointed General Manager.

Louisville, New Albany & Chicago.—R. W. Glading has been appointed Purchasing Agent, vice A. S. Dunham resigned.

Memphis & Charleston.—Henry Fink has been elected Vice-President, and E. B. Thomas appointed General Manager.

Missouri Pacific.—F. B. Drake has resigned the position of Superintendent, to accept the management of an Ohio road.

Minnesota & Northwestern.—C. McMichael has been appointed Superintendent of Des Moines Division, running from Oelwein to Des Moines.

Natchez, Jackson & Columbus.—T. S. Williams has resigned as General Superintendent.

New Mexico & Arizona.—H. T. Richards has been appointed Superintendent, vice J. H. Scott, resigned.

Northern Pacific.—C. P. Cole has been appointed Superintendent of Cascade and Pacific divisions, vice Otis Sprague, resigned. A. M. Miller has been appointed Master Mechanic of Cascade Division.

Peoria & Pekin Union.—Jas. W. Hill has been appointed Master Mechanic, in place of R. F. Hurd, resigned.

Philadelphia & Reading.—H. J. Small has been appointed Assistant Superintendent of Motive Power at the Reading shops; and C. M. Lawler succeeds A. A. Hesser as Superintendent of Mahanoy Division.

Sonora.—J. F. Goddard has been appointed General Manager.

Texas Western.—John H. Gray has been appointed General Superintendent.

Employment.

MANAGER WANTED.—An active, brainy man, fully posted in Car Wheel and General Foundry Work, with capacity to successfully operate a large establishment in the Southwest, and who can give the best references. Address "Car Wheel," office of NATIONAL CAR AND LOCOMOTIVE BUILDER. 2t

SALESMAN WANTED.—An active man, fully posted on the construction and operating of a Locomotive, to introduce a new article. One that has been in the position of railroad superintendent or master mechanic preferred. Must have a good address, and come well recommended by the corporation which formerly employed him. Address "Salesman," office of NATIONAL CAR AND LOCOMOTIVE BUILDER.